QUALITY ASSURANCE PROJECT PLAN

RCRA Facility Investigation

at

DETROIT COKE CORPORATION
DETROIT, MICHIGAN
U.S. EPA ID Number MID099114704

Prepared for:

Detroit Coke Corporation
7819 West Jefferson
P.O. Box 09229
Detroit, Michigan 48209

Prepared by:

HORIZON ENVIRONMENTAL
4595 Broadmoor Avenue SE
Suite 200
Grand Rapids, Michigan 49512

April 1996

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HORIZON ENVIRONMENTAL

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REVISION 0

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Paul Choinski
Detroit Coke, RFI Project Manager

Allen J. Reilly
Horizon Environmental, RFI Project Manager

Craig A. VandenBerge
Horizon Environmental, RFI Technical Manager

Jeffrey C. Sutherland
Horizon Environmental, RFI Quality Assurance Director

Greg Rudloff
U.S. EPA, Project Coordinator

U.S. EPA, Regional Quality Assurance Manager

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LIST OF ACRONYMS/ABBREVIATIONS

CDO	Central District Office
CRL	Central Regional Laboratory
DMP	Data Management Plan
DQO	Data Quality Objectives
EL	Environmental Laboratory
ES	Environmental Services
FSP	Field Sampling Plan
GC/MS	Gas Chromatograph/Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
PMP	Project Management Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Release Assessment
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
MDNR	Michigan Department of Natural Resources

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) requires that all environmental monitoring and measurement efforts mandated or supported by the U.S. EPA participate in a centrally managed quality assurance (QA) program.

Any party generating data under this program has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure the responsibility is met uniformly, each party must prepare a written QA Project Plan (QAPP) covering each project it is to perform.

This QAPP presents the organization, objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities associated with the RCRA Facility Investigation (RFI) scope of work for the Detroit Coke site. This QAPP also describes the specific protocols which will be followed for sampling, sample handling and storage, chain-of-custody, and laboratory analysis. All QA/QC procedures will be conducted in accordance with applicable professional technical standards, U.S. EPA requirements, governmental regulations and guidelines, and specific project goals and requirements.

This QAPP has been prepared by Horizon Environmental, in accordance with U.S. EPA guidance manual entitled, *Region 5 Model RCRA Quality Assurance Project Plan* (May 1993). It is to be read in conjunction with the Project Management Plan (PMP), the Field Sampling Plan (FSP), and the Data Management Plan (DMP).

1.1.1 OVERALL PROJECT OBJECTIVES

Condition D of Detroit Coke's Underground Injection Control (UIC) permit (number M1-163-1W-0004) identifies 13 SWMUs (solid waste management units) requiring possible investigation and corrective actions under the U.S. EPA's RCRA Corrective Action Program. In the RCRA Corrective Action framework, the *purpose* of a RCRA Facility Investigation (RFI) is to evaluate thoroughly the nature and extent of the release of hazardous wastes or constituents and to gather screening data to support the corrective measures study.

Of the 13 SWMUs identified by U.S. EPA at the Detroit Coke Corporation facility, 4 have been the subject of a Release Assessment (RA). Detroit Coke elected to conduct an RA at

SWMUs 1, 2, 18 and 20, based on historical records and known housekeeping practices which suggest that a release has not occurred at these units. A report[1] summarizing the findings of the RA was approved by U.S. EPA in a letter dated December 13, 1995. Of the 4 SWMUs investigated during the RA, it was recommended that SWMUs 1, 2, and 20 be carried forward to the RFI phase of the corrective action program and SWMU 18 be dropped from further investigation during the RFI.

The remaining SWMUs have been grouped based on proximity and the materials handled. SWMUs 3, 5, 6, 19, and 21 have been grouped into the "By-Products Containment Area " and SWMUs 11, 12, and 13 have been grouped into the "Tar Tank Area". SWMU 15 will remain separate. The By-Products Containment Area, the Tar Tank Area, and SWMU 15 will be investigated as part of the scope of the RFI described herein. Additionally, SWMUs 1, 2, and 20 will be further investigated as recommended in the RA report.

In addition to the RA, an Expanded Hydrogeological Investigation of the Detroit Coke Facility was conducted concurrently with the RA to provide greater understanding of the hydrogeology beneath the facility and the relationships between the ground water flow regimes and the two rivers which form the southeast and southwest perimeters of the site.

Based on the results of the two investigations mentioned above, a perimeter approach to the RFI ground water investigation has been recommended for this site for the following reasons:

- The remaining SWMUs are in very close proximity to one another making the physical extent of an individual SWMU coincident with the adjacent SWMUs for all practical purposes;
- The hazardous constituents managed at the various SWMUs are similar to the degree that this similarity and the proximity of the SWMUs to one another precludes definitive determination of the source of a release on a SWMU specific basis;
- The facility, and the area in general, have been industrialized since the turn of the century enhancing the potential commingling of released constituents further limiting the potential to assign a release to a specific SWMU;

[1] *RCRA Facility Investigation Release Assessment*, Horizon Environmental Corporation, September, 1995

- Soils at the site exhibit ubiquitous nuisance level impact from nearly a century of air deposition of coal fines and other industrial byproducts and consequently exposure controls constitute the most reasonable and cost effective corrective action for this medium;

- Ground water beneath the site was not found to be within an aquifer used for potable supplies and/or industrial uses;

- Ground water was found to be limited to 2 thin saturated zones in the upper 50 feet of sediments underlying the site;

- The boundaries of the saturated zones in the downgradient direction are the Detroit and Rouge Rivers (in the horizontal dimension and are likely the discharge point for all ground water underlying the site) and in the vertical dimension the saturated zone is underlain by a thick interval of low permeability clay occurring anywhere from 10 feet below the ground surface distal from the rivers to 50 feet below the ground surface in proximity to the rivers;

- All SWMUs and remaining physical structures at the site are currently in the demolition process limiting their potential as an ongoing source; and

- Following corrective action to control exposures to soils at the site the only remaining reasonable and relevant exposure pathway for contaminants is via ground water discharging into one or the other of the adjacent rivers.

Consequently, in addition to defining potential direct human contact exposures to soil, the primary focus of the RFI will be to define ground water flow conditions at the perimeter of the site where there may be a potential for uncontrolled exposures to occur.

1.1.2 PROJECT STATUS/PHASE

As mention ed previously, subsequent to the U.S. EPA's RCRA Facility Assessment (RFA) Horizon began the Corrective Action process at the Detroit Coke facility by conducting a RA involving four SWMUs, the remainder of the SWMUs (9) were to move forward to the RFI without preliminary investigation. The RA was completed in 1995 resulting in the removal of one of the four SWMUs involved in the RA, SWMU 18, the remainder, SWMUs 1, 2, and 20, will move forward to the RFI along with the nine SWMUs previously defined by the RFA.

Currently, the facility is moving forward with the RFI scope of work which incorporates the three SWMUs which were moved forward from the RA and the remaining nine SWMUs defined by the RFA. A complete description of the scope of the RFI, as currently planned, is presented in the Project Management Plan. Based upon the results of the scope described therein, it may become necessary to incorporate additional phases of investigation within the RFI framework of the Corrective Action Program being implemented at the site. However, to the extent possible, additional phases will be preempted by preparing addenda to the current RFI scope of work, as necessary, and conducting such work in an ongoing progression. This strategy of preparing and implementing addenda is intended to minimize both the cost and duration of the RFI phase of work.

1.1.3 QAPP PREPARATION GUIDELINES

The QAPP covers all RFI data collection in order that the sampling performed in each media will meet the desired data quality objectives (DQO). This will ensure that all the data collected as part of the RFI will be useful for the purposes intended. This QAPP has been prepared by Horizon Environmental in accordance with the *Region 5 Model QAPP* (May 1993), provided by the U.S. EPA RCRA RA Project Coordinator.

1.2 SITE/FACILITY DESCRIPTION

1.2.1 LOCATION

The Detroit Coke Corporation facility is located at 7819 West Jefferson Avenue in Detroit, Michigan (Wayne County, T2S, R11E, Private Claim 67). The location of the facility is shown in Figure 1-1.

1.2.2 FACILITY/SITE SIZE AND BORDERS

The Detroit Coke Corporation facility occupies approximately 60 acres. The facility is located at the north side of the northern confluence of the Rouge and Detroit Rivers. The property immediately surrounding the facility is industrial; however, the facility is located approximately 1,000 feet southeast of a residential neighborhood; approximately 0.5 miles southeast of McMillian School; 0.5 miles southeast of Good Hope School; approximately 0.5 miles south of Cary School; 1.25 miles west of Prince Road Park, and about 1.75 miles west of a hospital near Sandwich, Ontario.

1.2.3 NATURAL & MANMADE FEATURES

Detroit Coke is located in a heavily industrialized area along the Detroit and Rouge Rivers, as shown in Figure 1-1. Both rivers are used for transport of bulk materials by barge as well as recreational boating and fishing.

1.2.4 TOPOGRAPHY

Site topography is shown in Figure 1-1. The site is relatively flat with an elevation of around 590 feet above mean sea level (MSL). Ground surface at the site slopes gently toward the Detroit River to the east and the Rouge River to the south. Surface elevations range from about 590 feet MSL in the north to about 580 feet MSL adjacent to the rivers.

1.2.5 LOCAL GEOLOGY & HYDROGEOLOGY

1.2.5.1 Soils and Geology

The site is located within a glacial lake plain once occupied by ancestral Lake Erie. The surficial geology of the site consists of fill material underlain by approximately 100 feet of glacial deposits including alluvial deposits, lacustrine and deltaic sand, lacustrine clay, and lacustrine and deltaic loam. These sediments were deposited during the Wisconsinan stage of the Pleistocene glaciation, and are related to the advance and withdrawal of the Erie-Huron ice lobe.

Bedrock formations immediately underlying the glacial deposits consist of approximately 4,000 feet of Paleozoic sedimentary deposits which dip northwest at approximately 30 feet/mile.

1.2.5.2 Ground Water

The uppermost permeable unit at the site is the surficial fill material of up to, but generally less than, ten feet in thickness. Beneath the fill, alluvial deposits consisting of sand, gravel, silt and clay; along with glacial lake plain deposits of clay and varying amounts of coarser material occur beneath the fill. Ground water in varying quantities is available within these units. The regional ground water flow within these units is to the southeast toward the Detroit and Rouge Rivers.

Public drinking water is obtained primarily from surface water sources and supplied by the Detroit Metro Water Department. The surface water sources include Lake St. Claire, Detroit River, Clinton River, River Rouge, Huron River and inland lakes. There are some private wells in the area that obtain water from the glacial deposits, the Berea Sandstone or the Sylvania Sandstone.

1.3 SITE/FACILITY HISTORY

1.3.1 General History

The Detroit Coke Corporation was a coking facility which also produced coal tar and coke oven gas as byproducts. The coke was supplied to foundries for use as a fuel in cupolas. The coal tar was sold to a local coal tar refiner; and the coke oven gas was either used as a fuel on-site, sold, or flared.

Operations began at the facility in the early 1900's when the first battery of coke ovens was constructed. Detroit Coke has owned the facility since 1980. Detroit Coke operated the #4 battery from January 1980 until September 1991 when operations ceased and the plant was closed.

1.3.2 Past Data Collection Activities

General: A Toxic Release Inventory for the Detroit Coke site was reported in 1990. The U.S. EPA has also prepared an RFA for the Detroit Coke facility. The RFA report, dated December 2, 1992, was based on materials found in facility and agency files, the preliminary RFA submitted by Detroit Coke, and the Visual Site Inspection performed by the agency on July 15-16, 1992. The U.S. EPA determined that the facility has 13 SWMUs requiring additional investigation and possible corrective action.

Air: The facility operates under MDNR and Wayne County Air Commission Control standards.

Surface Water: To date, no surface water sampling has taken place at the site.

Soil: Refer to "RCRA Facility Investigation Release Assessment", Horizon Environmental Corporation, September, 1995.

Ground Water: Same as for soil.

1.3.3 CURRENT STATUS

Coking operations ceased at the facility in September 1991. The facility is currently used to store and load bulk coal, coke, and limestone. Since the closure of coking operations, Detroit Coke has emptied and removed tanks, pipelines, and containment units at the facility. Select facility buildings are also in the process of, or slated for, demolition. Interim Measures taken at the site pursuant to the RFA include:

- Accumulated coal tar residuals are in the process of being removed from SWMU 11;
- Underground lines such as coke oven gas lines have been removed;
- Pre-demolition asbestos abatement has been performed;
- No. 6 fuel oil tank has been removed; and
- Under contract to Detroit Coke, Murphy Demolition, Inc. is in the process of demolishing about 95% of site structures, excluding warehouses.

1.4 PROJECT OBJECTIVES

1.4.1 SPECIFIC OBJECTIVES AND ASSOCIATED TASKS

The following are the specific RFI objectives and associated tasks:

OBJECTIVE	TASKS
• Establish the Site Target List for soil and ground water analytical parameters.	• Resample surface soil at RA background sample location BG-04 and analyze for a Volatile Organic Compounds (U.S. EPA Method 8260) and the "Michigan 10 Metals" on an expedited turn around schedule. • Collect 57 surface soils from the two large SWMU areas. • Preserve all samples for potential laboratory analysis and field screen visually and using a PID for evidence of impact. • Select one surface soil sample from each of the two areas based on ~~filed~~ field screening such that the sample has the greatest potential for impact and analyze for Semi-Volatile and Volatile Organic Compounds and the "Michigan 10 Metals" on an expedited turn around schedule. • Review the expedited analytical results and determine what, if any, constituents should be added to the Site Target List for soils (aromatic hydrocarbons and BNAs including pyridine). • Review any additions to the target list for soils to determine if any of those constituents should be added to the target list for ground water.

OBJECTIVE	TASKS
• Determine whether surface soils at the Tar Tank Area SWMUs, By-Products Containment Area SWMUs and SWMU 15 are a direct human contact risk.	• Collect 5 surface soil samples at SWMU 15. Preserve for laboratory analysis and field screen the samples. • Select 25% of the soil samples collected from each of the two large SWMU areas for laboratory analysis based on field screening results: those showing the greatest evidence of impact will be analyzed for the site target list parameters for soil. (it may be necessary to extract these samples for VOC and SVOC scans to extend their hold time long enough to allow development of the Site Target List for soils). • Screen results against relevant direct human contact and background criteria under Act 307.
• Determine the background soil concentration for any additional parameters to the Site Target List for soil, as appropriate (especially metals).	• Collect 8 background soil samples and analyze for the constituents of interest. Establish background value in accordance with MDNR guidance.*
• Determine upgradient ground water quality with respect to any new parameters on the Site Target List for ground water and supplement the background water quality data base for parameters carried forward from the RA.	• Sample upgradient monitoring wells MW-4 and MW-5 and analyze for parameters on the Site Target List for ground water.

* MDNR Guidance Document for Verification of Soil Remediation, April 1994.

OBJECTIVE	TASKS
• Determine whether ground water proximate to the SWMUs is impacted due to constituents on the Site Target List for ground water.	• Install well clusters (one shallow water table well and one deeper unit well) downgradient of the Tar Tank Area SWMUs and the By-Products Containment Area SWMUs. • Install deeper unit companion wells to the RA water table wells at SWMUs 1, 2, and 20. • Install one shallow water table well downgradient of SWMU 15. • Sample these wells. • Analyze all ground water samples for parameters on the Site Target List for ground water.
• Determine ground water at the downgradient site perimeter poses a risk to the rivers.	• Install well clusters (one shallow water table well and one deeper unit well) downgradient of the large SWMU areas and directly adjacent to each river. • Sample these wells and existing 2-inch piezometers P-3S, P-4S, P-4D, P-5S, and P-5D.

The sampling locations are presented in Section 4.3 of the PMP and sampling protocols are presented in the FSP.

1.4.2 PROJECT TARGET PARAMETERS AND INTENDED DATA USAGES

Sample matrices, analytical parameters and frequencies of sample collection are presented in Table 1-1. The rationale for these parameters and frequencies is described in Section 4.0 of the PMP. Tables 7-1 and 7-3 contain the list of required parameters, the proposed analytical methods, and the expected detection limits.

1.4.2.1 Field Parameters

The field parameters to be measured are listed in Table 1-1.

1.4.2.2 Laboratory Parameters

The laboratory parameters to be analyzed for are listed in Table 7-3. This list of indicator parameters includes base/neutral/acid semi-volatile organic compounds [BNAs including pyridine where coking by-products were handled or polynuclear aromatic compounds (PNAs) where oil or coal tar was handled] and purgeable aromatic hydrocarbons. The rationale for the selection of these parameters is presented in Section 4.0 of the PMP.

Additional analytical parameters may be added subsequent to resampling and analysis of RA worst case soils located at BG-4 for volatile organic compounds and the "Michigan 10 Metals". Additionally, worst case soils from the Tar Tank Area and By-Product Containment Area will be analyzed for volatile and semi-volatile organic compounds and the "Michigan 10 Metals". See Section 4.0 of the PMP for additional details.

1.4.3 DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative statements which specify the quality of the data required to support decisions made during RFI activities. The desired DQOs selected are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. Five analytical levels address various data uses and the QA/QC effort and methods required to achieve the desired level of quality. Table 1-1 summarizes the DQOs for the RFI sampling. These levels are:

- Screening (DQO Level 1): This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to Applicable or Relevant and Appropriate Requirements (ARARs), initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of PID real-time monitoring equipment at the site.

- Field Analyses (DQO Level 2): This provides rapid results and better quality than in Level 1. This level may include mobile lab generated data depending on the level of quality control exercised.

- Engineering (DQO Level 3): This provides an intermediate level of data quality and is used for site characterization. Engineering analyses may include mobile lab generated data and some analytical lab methods (e.g., laboratory data with quick turnaround used for screening but without full quality control documentation).

- Confirmational (DQO Level 4): This provides the highest level of data quality and is used for purposes of risk assessment and evaluation of remedial alternatives. These analyses require full Contract Laboratory Program (CLP) SW-846 like analytical and data validation procedures in accordance with U.S. EPA recognized protocol. This level of DQO will be employed for all RFI samples collected for quantitative analysis.

- Non-Standard (DQO Level 5): This refers to analyses by non-standard protocols, for example, when exacting detection limits or analysis of an unusual chemical compound is required. These analyses often require method development or adaptation. The level of quality control is usually similar to DQO Level 4 data.

1.5 SAMPLE NETWORK DESIGN AND RATIONALE

The RFI sampling network and design are in part predicated upon the results of the RA conducted at the site in 1995. Additionally, an expanded hydrogeological investigation, conducted concurrently with the RA, has provided valuable subsurface stratigraphic data regarding the distribution of sediments beneath the site. Using these sources of ground water quality and ground water occurrence data, along with SWMU specific data regarding the two groups of SWMUs that are yet to be investigated, the rationale for both the soil and ground water sampling network to be employed during this initial phase of the RFI have been developed. See Section 4.3 of the PMP for more details regarding the scope of the investigation to be undertaken during this initial phase of the RFI.

Data obtained during the RFI will be input into a Data Management System (DMS) to provide a flexible means to combine and evaluate all of the available data to meet the stated objectives. The DMS will allow data to be compiled in numerous combinations and viewed graphically. The flexibility of the DMS will also facilitate the transfer of the data to other software packages such as geostatistical programs (see DMP).

Direct sampling and analysis will be used to evaluate the impacted media at the site. The following sections describe the general technical approach within each media to be investigated. The actual survey and sampling locations are presented in the FSP.

1.5.1 Sample Network by Task and Matrix

Sample matrices, analytical parameters, and frequencies of sample collection can be found in Table 1-1.

1.5.2 Site Map of Sampling Locations

The intended soil and ground water sampling locations are shown on Figures 4-3 and 4-3 of the PMP. It is possible, however, that depending on the nature of encountered field conditions some of these locations will be changed. The person who shall be responsible for making such decisions will be the Horizon Environmental RFI Coordinator whose responsibilities are described in Section 2.5 of this QAPP.

1.5.3 Rationale of Selected Sampling Locations

The rationale for why the selected sampling locations and depths were chosen in conjunction with each SWMU is described in Section 4.0 of the PMP.

1.5.4 Sample Network Summary Table

The RFI sample network is presented in tabular format on Table 1-1.

1.6 PROJECT SCHEDULE

The schedule for the RFI investigation is presented on Figure 1-2. This schedule presents the estimated time necessary to complete each task described in the PMP. The actual time required to implement the investigation will be dependent upon changes in scope, upon the amount of contingency sampling required and possibly upon other factors beyond Detroit Coke's control.

1.6.1 ANTICIPATED DATE OF PROJECT MOBILIZATION

The date of project mobilization is dependent upon U.S. EPA's approval of the various project plans (PMP, FSP, DMP and QAPP).

1.6.2 TASK BAR CHART AND ASSOCIATED TIME FRAMES

A task bar chart and the associated time frames are presented in Figures 1-2 of the QAPP and 4-4 of the PMP.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

At the direction of the U.S. EPA Project Coordinator, Detroit Coke and Horizon Environmental (as Detroit Coke's contractor) have overall responsibility for the direction and quality of all phases of the RFI. Horizon Environmental will be responsible for the quality of the work including QA/QC and will perform the scope of work as directed by Detroit Coke. Project Management will be provided by Horizon Environmental under the direction of Detroit Coke. Soil and ground water samples will be shipped to TriMatrix's Environmental Laboratory at 5555 Glenwood Hills Parkway SE in Grand Rapids, Michigan 49588-0874. The various quality assurance and management responsibilities of key project personnel are defined below.

2.1 PROJECT ORGANIZATION CHART

The lines of authority for the RFI are illustrated in Figure 2-1. This chart includes all individuals discussed below.

2.2 MANAGEMENT RESPONSIBILITIES

- *U.S. EPA RFI Project Coordinator:* The U.S. EPA *Project Coordinator,* Greg Rudloff, has the overall responsibility for regulatory oversight of all phases of the RFI scope of work.

- *Detroit Coke RFI Site Manager:* Paul Choinski, the RFI Site Manager is responsible for procuring corporate resources as necessary to meet project objectives. He will communicate Detroit Coke corporate concerns and insights to the Horizon Environmental RFI Project Manager for implementation.

- *Detroit Coke RFI Project Manager:* Paul Choinski, the Detroit Coke RFI Project Manager, is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The Detroit Coke RFI Project Manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The Detroit Coke RFI Project Manager will report directly to the U.S. EPA RFI Project Coordinator and will provide the major point of contact and control for matters concerning the project. The Detroit Coke RFI Project Manager will:

- define project objectives and develop a detailed work plan schedule;
- establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- orient all field leaders and support staff concerning the project's special considerations;
- monitor and direct the field leaders;
- develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- review and analyze overall task performance with respect to planned requirements and authorizations;
- approve all external reports (deliverables) before their submission to U.S. EPA Region 5;
- ultimately be responsible for the preparation and quality of monthly progress reports, draft and final design specifications, and final construction report; and
- represent the project team at meetings and public hearings.

• *Horizon Environmental RFI Project Manager:* Allen Reilly is the Horizon Environmental RFI Project Manager. At the discretion of the Detroit Coke RFI Project Manager, a number of the Detroit Coke RFI Project Manager's responsibilities may be directly delegated to the Horizon Environmental RFI Project Manager. The Horizon Environmental RFI Project Manager will provide direction for the entirety of the Horizon Environmental project team and be responsible for communications and project deliverables to Detroit Coke. Responsibilities held jointly with the Detroit Coke RFI Project manager will include:

  - approval of all external reports (deliverables) before their submission to U.S. EPA Region 5;

- the preparation and quality assurance of monthly progress reports, draft and final design specifications, and final construction report; and
- representation of the project team at meetings and public hearings.

- *Horizon Environmental RFI Technical Manager*: Craig VandenBerge is the Horizon Environmental RFI Technical Manager. At the discretion of the Detroit Coke RFI Project Manager, a number of the Detroit Coke RFI Project Manager's responsibilities may be directly delegated to the Horizon Environmental RFI Technical Manager. Responsibilities held jointly with the Detroit Coke RFI Project manager will include:

    - acquisition and application of technical and corporate resources as needed to ensure performance within budget and schedule constraints;
    - monitoring and directing the field leaders;
    - developing and meeting ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
    - review of the work performed on each task to ensure its quality, responsiveness, and timeliness; and
    - review and analysis of overall task performance with respect to planned requirements and authorizations.

2.3 QUALITY ASSURANCE RESPONSIBILITIES

- *U.S. EPA Region 5 Quality Assurance Manager (RQAM)*: EPA RQAM has the responsibility to review and approve all Quality Assurance Project Plans (QAPPs). Additional U.S. EPA responsibilities include:

    - Conducting external Performance and System Audits of the TriMatrix Environmental Laboratory; and
    - Reviewing and evaluating analytical field and laboratory procedures.

- *Horizon Environmental RFI QA Director*: The Horizon Environmental RFI QA Director is Jeffrey Sutherland. The QA Director will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary to resolve any QA dispute. He is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, Horizon

Environmental's policies, and U.S. EPA requirements. Specific functions and duties include:

- providing QA audit on various phases of the field operations;
- reviewing and approval of QA plans and procedures;
- providing QA technical assistance to project staff; and
- reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Horizon Environmental RFI Project Manager.

- *TriMatrix RFI Laboratory Quality Assurance Officer:* The TriMatrix RFI Laboratory Quality Assurance Officer is Doug Kriscunas. As Laboratory QA Officer he:

  - oversees laboratory quality assurance;
  - oversees laboratory QA/QC documentation;
  - conducts detailed laboratory data review;
  - decides laboratory corrective actions, if required;
  - presents technical laboratory QA procedures;
  - prepares laboratory standard operation procedures; and
  - ensures that the laboratory protocols specified in the QAPP are followed.

Independent Laboratory Data Validation will be provided by Rick Rediske, Ph.D. Dr. Rediske is a chemist and was formerly Vice President of Environmental Services and Director of Earth Tech's Environmental Laboratory (formerly WW Engineering & Science) for 14 years before accepting his current position at the Grand Valley State University Water Resources Institute.

2.4 LABORATORY RESPONSIBILITIES

- *TriMatrix RFI President/General Manager:* The TriMatrix President/General Manager is Jerry Parmentier. As President/General Manager, Mr. Parmentier:

  - ensures all resources of the laboratory are available on an as-required basis;
  - oversees final analytical reports; and
  - ensures that the protocols specified in the QAPP are followed.

- *TriMatrix RFI Laboratory Project Manager:* The TriMatrix RFI Laboratory Project Manager is Doug Kriscunas. As Laboratory Project Manager Mr. Kriscunas:

  - coordinates laboratory analyses;
  - supervises in-house chain-of-custody;
  - oversees laboratory data review;
  - oversees preparation of analytical reports; and
  - approves final analytical reports prior to submittal to Horizon Environmental.

- *TriMatrix RFI Laboratory Sample Custodian:* The TriMatrix Laboratory Sample Custodian is Kristi Kriger. As Sample Custodian, she:

  - receives and inspects the incoming sample containers;
  - records the condition of the incoming sample containers;
  - signs appropriate documents;
  - verifies chain-of-custody and its correctness;
  - notifies Laboratory Project Manager of sample receipt and inspection;
  - assigns a unique identification number and customer number, and enters each into the sample receiving log;
  - initiates, with the help of the Laboratory Project Manager, transfer of the samples to appropriate laboratory sections; and
  - controls and monitors access/storage of samples and extracts.

The primary responsibility for project quality rests with the Detroit Coke RFI Project Manager in conjunction with the Horizon Environmental RFI project team. Independent quality assurance will be provided by the TriMatrix RFI Laboratory Project Manager and the Horizon Environmental RFI QA Director prior to the release of data packages.

2.5 FIELD RESPONSIBILITIES

- *Horizon Environmental RFI Coordinator:* Horizon Environmental RFI Coordinator, Charlene McGue, will be supported by the Horizon Environmental technical and field staff. She will be responsible for leading and coordinating the day-to-day activities of the various resource specialists under her supervision. The Horizon Environmental RFI

Coordinator is a highly experienced environmental professional and will report directly to the Horizon Environmental RFI Technical Manager. Specific Horizon Environmental RFI Coordinator responsibilities include:

- implementation of field-related plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- coordination and management of field staff including sampling and subcontractors;
- implementation of QC for technical data provided by the field staff including field measurement data;
- adherence to work schedules provided by the Horizon Environmental RFI Technical Manager;
- authorship, review, and approval of text and graphics required for field team efforts; and
- identification of problems at the field team level, discussion of resolutions with the Horizon Environmental RFI Technical Manager, and provision of communication between project team members and upper management.

• *Horizon Environmental RFI Technical and Field Staff:* The Horizon Environmental RFI technical and field staff for this project will be drawn from Horizon Environmental's multidisciplinary corporate resources. The technical and field staff will be utilized to gather and analyze data, and to prepare various task reports. All of the designated technical and field team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

The overall quality assurance (QA) objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide high quality results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

SOPs for laboratory analyses are provided in Appendix A[1]. The SOPs address the required accuracy, precision, and sensitivity of the analyses.

3.1 PRECISION

3.1.1 DEFINITION

Precision refers to how closely two or more measurements of the same parameters or property agree with each other. Duplicate measurements will be made in the field to determine the precision of the field measurement. Matrix spike duplicates will be used to assess laboratory precision.

3.1.2 FIELD PRECISION OBJECTIVES

The precision of the field measurements is determined by evaluation of duplicate measurements. For this site, only PID screening measurements will be performed. Duplicate readings will not be required for these measurements.

3.1.3 LABORATORY PRECISION OBJECTIVES

Measurement of precision is mathematically defined for laboratory analysis in Section 12.2.

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3.2 ACCURACY

3.2.1 DEFINITION

Accuracy is the degree of agreement between an observed value and an accepted reference value.

3.2.2 FIELD ACCURACY OBJECTIVES

The accuracy of the field data will be maintained by ensuring instruments are in good working condition and properly calibrated (see Section 6.1). The accuracy of the PID field screening will be evaluated in conjunction with the instrument calibration records to ensure the highest possible accuracy. Accuracy in the field will also be assessed through the use of equipment rinse and trip blanks and through adherence to all sample handling, preservation and holding time requirements.

3.2.3 LABORATORY ACCURACY OBJECTIVES

Laboratory accuracy is mathematically defined in Section 12.1. Accuracy control limits are given in the laboratory SOPs in Appendix A[1].

3.3 COMPLETENESS

3.3.1 DEFINITION

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

3.3.2 FIELD COMPLETENESS OBJECTIVES

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 12.3 of this QAPP. Field completeness for this project will be greater than 90 percent.

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3.3.3 LABORATORY COMPLETENESS OBJECTIVES

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 12.3 of this QAPP. Laboratory completeness for this project will be greater than 90 percent.

3.4 REPRESENTATIVENESS

3.4.1 DEFINITION

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of facility conditions.

3.4.2 MEASURES TO ENSURE REPRESENTATIVENESS OF FIELD DATA

Representativeness is a qualitative parameter which is dependent upon the proper design of the various monitoring programs and proper laboratory protocol. The monitoring plans are designed to provide data representative of site conditions. During development of these plans, consideration was given to the data presented in the RFA. Representativeness will be satisfied by requiring that the procedures detailed in the FSP are followed, proper sampling techniques are used, proper analytical procedures are followed and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field duplicate samples.

3.4.3 MEASURES TO ENSURE REPRESENTATIVENESS OF LAB DATA

Representativeness will be satisfied by insuring that proper analytical procedures are followed and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field duplicate samples.

3.5 COMPARABILITY

3.5.1 DEFINITION

Comparability expresses the confidence with which one data set can be compared with another. In most cases. To the extent that the data collection objectives and analytical methods are similar, data generated during the RFI are expected to be comparable to data that will be generated during the RFI.

3.5.2 MEASURES TO ENSURE COMPARABILITY OF FIELD DATA

Comparability is dependent upon proper design of the sampling program and will be satisfied by ensuring that the FSP and QAPP are followed. The methods used to collect field data will be consistent during the RFI ensuring comparability of field data.

3.5.3 MEASURES TO ENSURE COMPARABILITY OF LAB DATA

The extent to which existing and planned analytical data will be comparable depends on the similarity of the sampling and analytical methods as documented in this QAPP. Comparability is also dependent on similar QA objectives. The methods used to collect for analysis and the methods used to analyze samples will be consistent during the RFI, ensuring comparability of laboratory data.

3.6 LEVEL OF QUALITY CONTROL EFFORT

Equipment rinse blank, trip blank, field duplicate and matrix spike samples will be analyzed to assess the quality of the data resulting from the various monitoring programs implemented for this project. Equipment rinse and trip blanks consisting of deionized water will be submitted to the TriMatrix Laboratory to provide the means to assess the quality of the data resulting from the program. Equipment rinse blank samples are analyzed to check for procedural contamination at the site which may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spike/matrix spike duplicates (MS/MSD) provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. One MS/MSD will be collected for every 20 or fewer investigative samples.

The general level of the QC effort will be one field duplicate blank for every 10 or fewer investigative samples and one equipment rinse blank for every 10 or fewer investigative samples. One trip blank consisting of deionized organic-free water will be included along with each shipment of aqueous volatile organic compounds (VOCs) samples. The trip blank will be analyzed for VOCs only.

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs and double the volume for extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., ground water, soil).

The number of field duplicate samples, equipment rinse and trip blank samples, and matrix spike samples to be collected are detailed in the FSP and in Table 1-1. Sampling procedures are also specified in the FSP. A description of field QC sample collection guidelines is provided in the field SOPs contained in Appendix B.

4.0 SAMPLING PROCEDURES

The sampling procedures to be used in the RFI will be consistent for the purpose of this project. Sampling procedures are specified in Section 6.0 of the FSP.

The sampling locations and rationale are presented in the PMP. In summary, representative samples will be collected from potentially impacted media (soil and/or ground water) in the vicinity of the SWMUs, at one background location and at the down gradient perimeter of the site. Actual soil sample locations have been estimated and may be modified based on field observations (i.e. stained or cracked areas in secondary containment structures), with a bias toward obtaining samples of the most potentially impacted soils. Sampling depths have been determined based on SWMU characteristics and to assist in determining the potential risks that may arise from exposure(s) to shallow soils, primarily dermal. For example, if the SWMU structure is simply a shallow containment area, only soils at depths of 0 to 2 feet will be investigated, since any releases due to significant breaches in the containment or overflows will be evidenced at that depth. Soil samples will be collected at multiple depth intervals, during the installation of monitoring wells; however, it is not anticipated that soils from these deeper intervals will be quantitatively analyzed rather, a ground water sample will be collected for analysis.

4.1 FIELD SAMPLING BY MATRIX

The field sampling matrix is discussed in Section 4.3 of the PMP and in the FSP. Table 1-1 presents a summary of this information.

4.2 FIELD QC SAMPLE COLLECTION/PREPARATION PROCEDURES

4.2.1 OBTAINING CONTAMINANT-FREE SAMPLE CONTAINERS

The sample containers used for this RFI will be prepared in accordance with the U.S. EPA, 1990 guidance document, *Contaminant-Free Sample Containers*. The bottles used for sampling will not contain contaminants exceeding the level specified in the above mentioned document. I-Chem will issue a certificate of cleanliness for all bottles used. The certificate will be specific for the compounds of concern at the site (BNAs, BTEX and pyridine). Specifications for the bottles will be verified by checking the supplier's certified statement and analytical results for each bottle lot, and will be documented on a continuing basis. This data will be maintained in a central contractor file and will be available, if requested, for U.S. EPA review.

In addition, the data for equipment rinse blanks and trip blanks, etc., will be monitored for contamination, and corrective actions will be taken as soon as a problem is identified.

4.2.2 QC Sample Procedures

The number of duplicate and blank samples to be collected are listed in Table 1-1. Sample procedures are specified below and in the field SOP contained in Appendix B.

4.2.2.1 Equipment Rinse Blank Collection

Equipment Rinse Blanks are rinse water samples obtained after the final planned rinsing step for decontamination of bailers, split spoons, lead auger, etc. These blanks demonstrate that the non-dedicated sampling equipment has been thoroughly cleaned and that the sample collection and handling process has not altered the quality of the sample. The general level of the QC effort will be one equipment rinse blank for every 10 or fewer investigative samples. The equipment rinse blank samples will be analyzed for the same list of parameters as the ground water or soil sample with which they are collected.

4.2.2.2 Field Duplicative Collection

The general level of the QC effort will be one field duplicate for every 10 or fewer investigative samples. The field duplicate samples will be analyzed for the same list of parameters as the ground water or soil sample with which they are collected.

4.2.2.3 Matrix Spike/Matrix Spike Duplicate Collection

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs and double the volume for extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., ground water, soil).

4.2.2.4 Trip Blank Preparation

Trip Blanks are organic free water samples in VOC vials placed in lab chest that are renewed each time a chest is packed or repacked with VOC sample containers. These samples remain unopened in the chest. If these "blanks" show "detectable" for one or more compounds, the problem could be cross-contamination between sample and container via air in the chest, or lab contamination. One VOC trip blank consisting of distilled deionized ultra pure water will be prepared in TriMatrix's Laboratory and included along with each shipment of aqueous VOC samples.

4.3 SAMPLE CONTAINERS, PRESERVATIVES AND VOLUME REQUIREMENTS

Requirements for sample containers, preservation and volume are summarized on Table 7-2.

4.4 DECONTAMINATION PROCEDURES

Decontamination procedures are described in Section 5.0 of the FSP.

4.5 SAMPLE PACKAGING & SHIPMENT PROCEDURES

Sample packaging and shipment procedures are summarized on Table 7-2 and described in further detail in the field SOPs in Appendix B.

5.0 CUSTODY PROCEDURES

Custody is one of several factors which is necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if it is:

- in your possession;
- in your view, after being in your possession;
- in your possession and you place it in a secured location; or
- in your designated secure area.

A chain-of-custody record is a record of all persons who have collected, relinquished and/or received samples and the dates and times when these activities occurred. Items which must be held under a chain-of-custody include samples, sample tags, airbills and a chain-of-custody record form. The chain-of-custody will be initiated in the field and will be maintained through the laboratory. Additional information on the transfer of custody is provided in Section 5.1.3 of the QAPP.

An example of the chain-of-custody form is included in Appendix C.

5.1 FIELD CUSTODY PROCEDURES

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample labeling is included in Section 3.1 of the FSP.

5.1.1 FIELD PROCEDURES

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

- All bottles will be tagged with sample numbers and locations, date/time of collection, and type of analysis. The sample numbering system is presented in Section 3.1 of the FSP.

- A sample tag will be attached to each individual sample aliquot for each investigative or quality control sample. The sample tag will include the following information: the field sample number (which will include the location of the sample), date and time of collection, type of analysis, type of preservative (if any), a space for the lab sample number, project identification, and the name of the person collecting the sample. The tag may also include a space for comments. The sample tag will be attached to the sample container with a wire around the container neck through a reinforced hole in the tag. Sample tags will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ball-point pen would not function in freezing weather.

- The Horizon Environmental Project Coordinator will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

5.1.2 FIELD LOGBOOKS/DOCUMENTATION

Field logbooks will provide the means of recording data collection activities. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned;

- Logbook number;
- Project name;
- Project start date; and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered.

The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

A record will be kept of field measurements and collected samples. All entries will be made in ink, signed and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, signed and dated by the sampler. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 6.0 the FSP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. The sample identification number will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description. The system for assigning a sample identification number is described in Section 3.1 of the FSP.

5.1.3 TRANSFER OF CUSTODY AND SHIPMENT PROCEDURES

- Samples are accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

- Samples will be properly packaged on ice at 4°C for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

- Whenever samples are co-located with a government agency, a separate sample receipt is prepared for those samples and marked to indicate with whom the samples are being co-located. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "Received By" space.

- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment. The pink and yellow copies will be retained by the sampler for return to the sampling office.

- Airbills or bills of lading will be used when samples are sent by Federal Express, UPS, Airborne Express or Express Mail. Receipts of airbills or bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. The custody forms will be sealed inside the sample cooler and coolers will be sealed intact; therefore, the commercial carriers will not be required to sign off on the custody form.

- Whenever possible, samples will be transported by overnight carrier to the laboratory the same day the samples are collected in the field.

5.2 LABORATORY CUSTODY PROCEDURES

All samples will be received at the TriMatrix Laboratory by the Sample Custodian (SC). It will be the responsibility of the SC to determine whether or not the samples are close to exceeding their holding time and require immediate attention and the manner in which those samples will be split, preserved and stored or routed. It is the objective of the SC to insure that all pertinent information relative to those samples is recorded. This information may be used in client reports, communicated to the laboratory or to the client and, in some cases, reported to a legal authority relative to chain-of-custody samples.

The sample custodian is responsible for the receipt, log-in, and access controlled storage of all client samples at the TriMatrix Laboratory. Each sample is labeled with a unique number which is entered into the sample receiving log and LIMS system. The samples are placed into appropriate storage within an access controlled location. Sample extracts are signed out by the chemist performing the analysis and subsequently signed in when the samples are returned to the access controlled storage location. All samples are maintained under proper storage conditions for thirty days past the generation of the analytical report.

A chain-of-custody sample control record is used as the documentation for the movement of chain-of-custody samples in and out of the access controlled storage. The analyst signs samples in and out each time a sample (s) is removed for any analysis. A copy of the form is included in Appendix D[1]. After all analyses are complete, the sample custodian files the form in a chain-of-custody file specific to the project.

5.3 FINAL EVIDENCE FILES

The final evidence file will be the central repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this QAPP. The Horizon Environmental RFI Project Manager is custodian of the final evidence file and maintains the contents of evidence files for the RFI, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the Horizon Environmental RFI Project Manager.

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6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment which are used for conducting field and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

6.1 FIELD INSTRUMENT CALIBRATION

A photoionization detector (PID) will be used during the field investigation. All instruments will be calibrated at least daily according to manufacturer's instructions, and all calibration data shall be recorded in dedicated calibration logbooks or field logbooks. No other field measurements will be taken.

6.2 LABORATORY INSTRUMENT CALIBRATION

Calibration of laboratory equipment will be based on approved written procedures contained in the laboratory SOPs (Appendix A[1]) for the appropriate analytical method and listed in Table 6-1. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory analyst. These records will be filed at the location where the work is performed and will be subject to QA audit. For all instruments, the laboratory maintains in-house spare parts or service contracts with vendors.

6.2.1 ORGANIC ANALYSES

Prior to calibration, the instrument(s) used for gas chromatograph/mass spectrometer (GC/MS) analyses are tuned by analysis of p-bromofluorobenzene for VOC analyses and decafluorotriphenyl phosphine (DFTPP) for semi-volatile organic compound analyses (SVOCs). Once the tuning criteria for these reference compounds are met, the instrument is initially calibrated by using a five point calibration curve. The instrument tune will be verified each 12 hours of operation. Continuing calibration is verified as specified in the method. The calibration standards are commercially available certified standards and are spiked with internal standards and surrogate compounds.

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Analysis done by gas chromatography will basically follow SW-846 protocols. The instrument will be calibrated using a five point calibration curve for volatile compounds and a five point calibration curve for semi-volatile compounds. Continuing calibrations shall be performed after every ten samples.

7.0 ANALYTICAL AND MEASUREMENT PROCEDURES

All ground water and soil samples collected during field sampling activities for the Detroit Coke RFI will be analyzed by the TriMatrix Laboratory Division in Grand Rapids Michigan.

7.1 FIELD ANALYTICAL & MEASUREMENT PROCEDURES

The standardization and QA information for field measurements of *(VOC content in headspace)* is described in Section 3 of this QAPP. Field methodologies are provided in the FSP. The SOP for the headspace screening for VOC content is found in Appendix B.

7.2 LABORATORY ANALYTICAL & MEASUREMENT PROCEDURES

Standard operating procedures have been prepared for all methods used for analysis of samples for this project. These project specific laboratory SOPs are included in Appendix A[1].

Each of these SOPs is based on an analytical method published by the U.S. EPA. Each specifies:

- procedures for sample preparation;
- instrument start up and performance check;
- initial and continuing calibration check requirements;
- specific methods for each sample matrix type; and
- required analysis procedures.

7.2.1 LIST OF PROJECT TARGET COMPOUNDS & DETECTION LIMITS

Tables 7-1 through 7-3 provide a summary of analytical methods, bottle requirements, preservatives, holding times and project specific detection limits.

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7.2.2 List of Associated QC Samples

The laboratory SOPs include a QC section which addresses the minimum QC requirements for the analysis of specific analyte groups. Since the RFI is the first comprehensive investigation performed at the site, no specific compounds have been identified as chemicals of concern. Therefore, no specific compounds will be added to the spiking solution, rather normal QA/QC measures will be implemented.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD QC CHECKS

The QC information for field equipment is stated in Section 3.0 of this QAPP. Soil color checks, if required, will be done using Munsell color charts. Assessment of field sampling precision and bias will be made by collecting field duplicates and equipment rinse blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable procedures in Section 4.0 of this QAPP and Section 6.0 of the FSP.

8.2 LABORATORY QC CHECKS

The quality assurance program and quality control checks described in this section will be used by the TriMatrix Laboratory for production of analytical data of known and documented usable quality.

8.2.1 QUALITY ASSURANCE PROGRAM

The TriMatrix Laboratory has a written Quality Assurance/Quality Control (QA/QC) program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory's quality assurance officer.

The stated objectives of the laboratory QA/QC program are to:

- be sure that all procedures are documented, including any changes in administrative and/or technical procedures;
- be sure that all analytical procedures are conducted according to sound scientific principles and have been validated;
- monitor the performance of the laboratory by a systematic inspection program and provide for a corrective action as necessary; and
- be sure that all data are properly recorded and archived.

All laboratory procedures are documented in writing as standard operating procedures (SOPs) which are edited and controlled by the TriMatrix Laboratory. Internal quality control procedures for analytical services will be conducted by TriMatrix Laboratory in accordance with their standard operating procedures and the individual method requirements in a manner consistent with the TriMatrix Laboratory's QA/QC Procedures Manual (Appendix D[1]).

8.2.2 QUALITY CONTROL CHECKS

TriMatrix Laboratory SOPs include the types of audits required (sample spikes, surrogate spikes, reference samples, controls, blanks), the frequency of each audit, the compounds to be used for sample spikes and surrogate spikes, and the quality control acceptance criteria for these audits.

The TriMatrix Laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be reanalyzed by the laboratory. It is expected that sufficient volume of samples will be collected for reanalysis. Method specific data quality objectives for precision, accuracy and surrogate recoveries are found in Tables 8-1 and 8-2.

8.2.3 METHOD BLANK SAMPLES

A method blank sample will be analyzed by the laboratory at a frequency of one blank per twenty samples or batch, whichever is less. The method blank, an aliquot of laboratory reagent water or sand will be carried through the entire analytical procedure.

8.2.4 MS/MSD

Matrix spikes and duplicates will be analyzed at a frequency of one MS/MSD or MS/Duplicate per twenty investigative samples or batch, whichever is less. Spike recoveries will be used to evaluate analytical accuracy while relative percent difference between the duplicate analyses will be used to assess precision.

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8.2.5 SURROGATE COMPOUNDS

Surrogate compounds are used in all GC/MS procedures. All samples including blanks, spikes and control samples are spiked with surrogate compounds prior to analysis. Surrogate spike recoveries must fall within the control limits listed in Table 8-2. Failure to pass these criteria will result in reanalysis to verify the existence of a matrix interference. Dilution of samples may dilute the surrogates out of the quantitation limit.

8.2.6 LABORATORY CONTROL SAMPLES

A quality control check sample will be analyzed with each analytical batch or twenty samples, whichever is less. These samples are prepared by use of standards independent of the calibration standards, and are carried through the complete analytical process. Control limits are specified in the laboratory SOPs contained in Appendix A[1].

8.2.7 TRIP BLANKS

Trip blanks are submitted with volatile organic samples only, and will be used to determine if cross-contamination occurs during the shipment of samples.

The TriMatrix Laboratory routinely updates control limits for precision, accuracy and surrogate recoveries. The limits listed in Tables 8-1 and 8-2 may vary slightly when actual sampling begins.

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9.0 DATA REDUCTION, VALIDATION AND REPORTING

All data generated through in field activities, or by the laboratory operation shall be reduced, and validated prior to reporting. No data shall be disseminated by the laboratory until it has been subjected to these procedures which are summarized in subsections below:

9.1 DATA REDUCTION

9.1.1 FIELD DATA REDUCTION PROCEDURES

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Direct measurement readings will be taken from the PID following calibration per manufacturer's recommendations as outlined in Section 6 of this QAPP. Such data will be written into field log books immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Later, when the results forms required for this study are being filled out, the Horizon Environmental RFI Coordinator, identified in Section 2.0 of this QAPP, will proof the forms to determine whether any transcription errors have been made by the field crew.

9.1.2 LABORATORY DATA REDUCTION PROCEDURES

TriMatrix Laboratory will perform in-house analytical data reduction under the direction of the Laboratory QA Officer.

Data reduction by the laboratory will be conducted as follows:

- Raw data produced by the analyst is turned over to the respective area supervisor.
- The area supervisor reviews the data for attainment of quality control criteria as outlined in established U.S. EPA methods and for overall reasonableness.
- Upon acceptance of the raw data by the area supervisor, a computerized QA report is generated and sent to the Laboratory QA Officer.

9.2 DATA VALIDATION

9.2.1 PROCEDURES USED TO VALIDATE FIELD DATA

Procedures to evaluate field data for this project primarily include checking for transcription errors and review of field log books, on the part of field crew members. This task will be the responsibility of the Horizon Environmental RFI Coordinator, who will otherwise not participate in making any of the field measurements, or in adding notes, data or other information to the log book.

9.2.2 PROCEDURES USED TO VALIDATE LAB DATA

The TriMatrix Laboratory will perform in-house analytical data validation under the direction of the Laboratory QA Officer. The Laboratory QA Officer is responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other notations which would caution the data user of possible unreliability.

Data validation by the laboratory will be conducted as follows:

- The Laboratory QA Officer will complete a thorough audit of preliminary reports at a frequency of one in ten.
- The Laboratory QA Officer and area supervisors will decide whether any sample reanalysis is required.

The TriMatrix assessment of laboratory data will be accomplished by the joint efforts of the TriMatrix Laboratory QA Officer and TriMatrix RFI Laboratory Project Manager. The data assessment by the Laboratory Project Manager will be based on the assumption that the sample was properly collected and handled according to the FSP and Section 2.5 of this QAPP.

The TriMatrix data reviewers will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate and blank results provided by the

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laboratory. An evaluation of data accuracy, precision, sensitivity and completeness based on criteria discussed in Section 3.0 of this QAPP will be performed.

Data validation independant of the TriMatrix Laboratory as discussed in Section 2.3 of this QAPP will be performed at a frequency of one hundred percent.

The data reviewers will identify any out-of-control data points and data omissions and will interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Horizon Environmental RFI Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

9.3 DATA REPORTING

9.3.1 FIELD DATA REPORTING

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities. If field logbook information is to be used in the project reports, it will likely be presented in a tabular format.

9.3.2 LABORATORY DATA REPORTING

Upon acceptance of the preliminary reports by the Laboratory QA Officer, final reports will be generated and signed by the Laboratory Project Manager. The laboratory package shall be presented in the same order in which the samples were received.

TriMatrix Laboratory will prepare and retain full analytical and QC documentation similar to that required by the contract laboratory program. Such retained documentation need not be hard (paper) copy, but may be in other storage media (e.g., magnetic tape). TriMatrix Laboratory will supply a hard copy of the retained information on an as needed or as requested basis.

TriMatrix Laboratory will report the data in the same chronological order in which analyses are conducted, along with QC data. Each analytical data package will include the following:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;
- tabulated results of organic compounds identified and quantified for investigative and blank samples;
- analytical results for sample spikes, sample duplicates, and laboratory control samples; and
- tabulation of instrument detection limits determined in pure water.

For organic analyses, surrogate spike recoveries, chromatograms, GC/MS spectra, computer printouts, calibration verification of standards and blanks, standard procedural blanks, raw data system printouts (or legible photocopies) identifying data of analyses, analyst's name, and parameters determined, will be retained by TriMatrix Laboratory. This data will be made available upon request.

All data generated for the Detroit Coke RFI will be computerized in a format organized to facilitate data review and evaluation. The Detroit Coke RFI data set will be available for controlled access by the Horizon Environmental RFI Project Manager and by authorized personnel using a site-specific code. The final data deliverables will be presented in a "CLP-like" format.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and the QAPP. The audits of field and laboratory activities include two separate independent parts: internal and external audits.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

10.1.1 INTERNAL FIELD AUDITS

10.1.1.1 Internal Field Audit Responsibilities

Internal audits of field activities including sampling and field measurements may be conducted by the Horizon Environmental QA Director.

10.1.1.2 Internal Field Audit Frequency

Internal field audits may occur at the onset of the project to verify that all established procedures are followed. Follow-up audits will be conducted in the event of deficiencies, to verify that required QA procedures are maintained throughout the investigation.

10.1.1.3 Internal Field Audit Procedures

Internal audits of field activities (sampling and measurements) may be conducted by the Horizon Environmental QA RFI Director and/or Horizon Environmental RFI Coordinator. The audits will include examination of field sampling and measurement records, field instrument calibration and operating records, and sample collection, handling, packaging, and documentation in compliance with the established procedures. The internal field audit checklist to be used for this project is included in Appendix C.

10.1.2 EXTERNAL FIELD AUDITS

10.1.2.1 External Field Audit Responsibilities

An external audit may be conducted at the discretion of the U.S. EPA RCRFI Project Coordinator.

10.1.2.2 External Field Audit Frequency

External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of the U.S. EPA.

10.1.2.3 Overview of the External Field Audit Process

External field audits will be conducted according to the field activity information presented in the QAPP.

10.2 LABORATORY PERFORMANCE AND SYSTEMS AUDITS

10.2.1 INTERNAL LABORATORY AUDITS

10.2.1.1 Internal Lab Audit Responsibilities

The internal performance and system audits of the TriMatrix Laboratory will be conducted by the TriMatrix Laboratory QA officer.

10.2.1.2 Internal Lab Audit Frequency

The system audits, which will be done on an annual basis, will include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedure, sample preparation and analysis, and instrument operating records.

10.2.1.3 Internal Lab Audit Procedures

The internal lab system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc. The performance audits will involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The TriMatrix Laboratory QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. The laboratory audit checklist is shown in Table 10-1.

10.2.2 EXTERNAL LABORATORY AUDITS

10.2.2.1 External Lab Audit Responsibilities

An external audit will be conducted at the discretion of the U.S. EPA Region 5 Central Regional Laboratory (CRL).

10.2.2.2 External Lab Audit Frequency

An external lab audit will be conducted at least once prior to the initiation of the sampling and analysis activities. These audits may or may not be announced and are at the discretion of the U.S. EPA.

10.2.2.3 Overview of the External Lab Audit Process

External lab audits will include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, review of "typical" data deliverables packages and/or submission of performance evaluation samples to the laboratory for analysis.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

11.1 FIELD INSTRUMENT PREVENTIVE MAINTENANCE

A PID will be used during the field investigation. Specific preventative maintenance procedures to be followed are those recommended by the manufacturer. This instrument will be checked and calibrated daily before use and as necessary thereafter. Backup instruments and equipment will be available on-site or within 1 day shipment to avoid delays in the field schedule.

11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

As part of their QA/QC program, a routine preventive maintenance program is conducted by TriMatrix Laboratory to minimize the occurrence of instrument failure and other system malfunctions. TriMatrix Laboratory staff performs preventive maintenance and repairs or coordinates with a vendor for the repair of all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis, and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives. The routine preventative maintenance procedures and schedules are presented in Table 11-1.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 ACCURACY ASSESSMENT

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Section 3.2 of the QAPP using the analytical results of method blanks, reagent/preparation blank MS/MSD samples, equipment rinse blank, and trip blanks. The percent recovery (%R) of matrix spikes will be calculated using:

$$\%R = \frac{A - B}{C} \times 100$$

Where:

A = the analyte concentration determined experimentally from the spiked sample;

B = the background level determined by a separate analysis of the unspiked sample; and

C = the amount of the spike added

12.2 PRECISION ASSESSMENT

Precision of laboratory analyses will be assessed by comparing the analytical results between MS/MSD for organic analyses. The relative percent difference (%RPD) will be calculated for each pair of duplicate analyses using:

$$\%RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = first sample value (original or MS value)

D = second sample value (duplicate or MSD value)

12.3 COMPLETENESS ASSESSMENT

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100$$

13.0 CORRECTIVE ACTIONS

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out of quality control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the Detroit Coke RFI Project Manager, or his designee. If immediate corrective action is required, approvals secured by telephone from the Detroit Coke RFI Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the TriMatrix Laboratory QA Officer or Horizon Environmental RFI Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to Greg Rudloff, the U.S. EPA Project Coordinator and/or Nathan Wiser, also of the U. S. EPA and then to the U. S. EPA Quality Assurance Section. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established quality control procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. The Detroit Coke RFI Project Manager, or his designee, will issue a nonconformance report for each nonconformance condition.

13.1 FIELD CORRECTIVE ACTION

Corrective action in the field can be needed when the sample network is changed (i.e. more/less samples, sampling locations other than those specified in the QAPP, etc.), sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. Field and technical staff will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any field activity or issued document by reporting the situation to the Horizon Environmental RFI Coordinator or designee. The Horizon Environmental RFI Coordinator or designee will be responsible for assessing the suspected problems in consultation with the Horizon Environmental QA Director. A decision will be made based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the Horizon Environmental RFI Coordinator or designee.

The Horizon Environmental RFI Coordinator or designee will then be responsible for initiating corrective action for nonconformances by:

- evaluating all reported nonconformances;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformances;
- reviewing nonconformance reports and corrective actions taken;
- verifying that nonconformance reports are included in the final site documentation in project files.

If appropriate, the Horizon Environmental RFI Coordinator or designee will see that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

The Horizon Environmental RFI Coordinator or designee is responsible for all site activities. In this role, the Horizon Environmental RFI Coordinator at times is required to adjust the site programs to accommodate site specific needs. When it becomes necessary to modify a program, the responsible person notifies the Horizon Environmental RFI Coordinator of the anticipated change and implements the necessary changes after obtaining the approval of the Horizon Environmental RFI Coordinator. The change in the program will be documented on the field change request that will be signed by the initiators and the Horizon Environmental RFI Coordinator. The field change request for each document will be numbered serially as required. The field change request shall be attached to the filed copy of the affected document. The Horizon Environmental RFI Coordinator must approve the change in writing or verbally (followed by written notification) prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The Horizon Environmental RFI Coordinator or designee is responsible for controlling, tracking and implementing the identified changes. All changes will be reported by Detroit Coke in the monthly reports to the U.S. EPA contact, as discussed in Section 14 of the QAPP.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the U.S. EPA RCRA Project Coordinator.

13.2 LABORATORY CORRECTIVE ACTION

Corrective actions may be required for two classes of problems: analytical or equipment problems and noncompliance problems. Specific corrective actions are presented in the laboratory SOPs for each analytical method (Appendix A[1]). Specific corrective actions are not repeated in the text of this QAPP to avoid redundancy which could become burdensome during the RFI phase of corrective action, where the possible use of numerous additional analytical methods may be required.

Analytical or equipment problems may occur during sample preparation, laboratory instrumental analysis, or data review. Corrective measures for these types of problems are discussed in the following sections.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the TriMatrix Laboratory QA Officer or Horizon Environmental Project Manager. Implementation of corrective action for noncompliance problems will be confirmed in writing through the same channels.

[1] Bound Separately

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- blanks contain target analytes above acceptable levels;
- undesirable trends are detected in spike recoveries or Relative Pertinent Difference between duplicates;
- there are unusual changes in detection limits;
- deficiencies are detected by the Laboratory QA Officer during internal or external audits or from the results of performance evaluation samples; or
- inquiries concerning data quality are received.

In addition, the data for equipment rinse blanks and trip blanks, etc., will be monitored for contamination, and corrective actions will be taken as soon as a problem is identified. This will be accomplished either by discontinuing the use of a specific bottle lot, contacting the bottle supplier(s) for re-testing the representative bottle from a suspect lot, re-sampling the suspected samples, validating the data taking into account that the contaminants could be introduced by the laboratory (i.e., common lab solvents, sample handling artifacts, etc.) or could be bottle QC problem, so as to make an educated determination of whether the bottles and hence the data are still usable, etc., whichever is appropriate.

For this particular project, the corrective actions will be conducted in a comprehensive manner in order to avoid the use of identified contaminated lot(s), and to ensure that the bottle supplier(s) is deemed responsive and able to provide clean bottles as specified.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, and checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the Laboratory Project Manager or Operations Manager. Once resolved, full documentation of the corrective action procedure is filed with the RFI QA Director.

13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

The TriMatrix Data Assessor may identify the need for corrective action during either the data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required quality assurance objectives (e.g. the holding time for samples is not exceeded, etc.) When the TriMatrix Data Assessor identifies a corrective action situation, it is the Detroit Coke RFI Project Manager who will be responsible for approving the implementation of corrective action, including resampling, during data assessment. All corrective actions of this type will be documented by the Detroit Coke RFI Project Manager. Another laboratory will not be used without written approval of the U.S. EPA.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The deliverables associated with the tasks identified in the RFI Work Plan and bimonthly progress reports will contain separate QA sections in which data quality information collected during the task is summarized. Those reports will be the responsibility of the Detroit Coke Project Manager and will include the TriMatrix Laboratory QA Officer report on the accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and any corrective action needed or taken during the project, provided analytical data were generated during that period.

14.1 CONTENTS OF PROJECT QA REPORTS

The QA report (expected to cover one analytical event) will contain a discussion of any qualified data, provide justification for its use and/or if necessary, recommend that supplemental data be collected to replace the affected data set.

14.2 FREQUENCY OF QA REPORTS

Due to the limited scope of RFI, the QA reports will be provided on a bimonthly basis, along with the bimonthly progress reports described in Section 4.1 of the PMP.

14.3 INDIVIDUALS RECEIVING/REVIEWING QA REPORTS

All individuals identified in the Project Organization chart will receive copies of the bimonthly QA report.

TABLES

TABLE 1-1
Summary of Sampling and Analysis Program
RCRA Facility Investigation
Detroit Coke Corporation
Detroit , Michigan

Location	Matrix	Field Parameters	Laboratory Analysis*	Investigative Samples	Duplicates	Blanks** Eq. Rinse	Trip*	MS/MSD	DQO
Tar Tank Area	Soil	Visual, PID Screening	---	35	NA	NA	NA	NA	I
Tar Tank Area	Soil	Visual, PID Screening	U.S. EPA Methods 8260 & 8270, Metals	1	NA	NA	NA	NA	I
Tar Tank Area	Soil	Visual, PID Screening	Site Target List for Soils, as amended	8	1/10	1/10	NA	1/20	IV
By-Products Area	Soil	Visual, PID Screening	---	22	NA	NA	NA	NA	I
By-Products Area	Soil	Visual, PID Screening	U.S. EPA Methods 8260 & 8270, Metals	1	NA	NA	NA	NA	I
By-Products Area	Soil	Visual, PID Screening	Site Target List for Soils, as amended	6	1/10	1/10	NA	1/20	IV
SWMU 15	Soil	Visual, PID Screening	Site Target List for Soils, as amended	5	1/10	1/10	NA	1/20	I/IV
Background (BG-04)	Soil	Visual, PID Screening	U.S. EPA Method 8260 & Metals	1	1/10	1/10	NA	1/20	I/IV
Background	Soil	Visual, PID Screening	Metals	7	1/10	1/10	NA	1/20	I/IV
SWMU 1	GW	---	Site Target List for GW, as amended	1	1/10	1/10	1/shipment	1/20	IV
SWMU 2	GW	---	Site Target List for GW, as amended	1	1/10	1/10	1/shipment	1/20	IV
SWMU 20	GW	---	Site Target List for GW, as amended	1	1/10	1/10	1/shipment	1/20	IV
SWMU 15	GW	---	Site Target List for GW, as amended	1	1/10	1/10	1/shipment	1/20	IV
By-Products Area	GW	---	Site Target List for GW, as amended	2	1/10	1/10	1/shipment	1/20	IV
Site Perimeter	GW	---	Site Target List for GW, as amended	9	1/10	1/10	1/shipment	1/20	IV
Upgradient Ground Water	GW	---	Site Target List for GW, as amended	2	1/10	1/10	1/shipment	1/20	IV

NA - not applicable
* See Table 7-3 of the QAPP for parameter list.
* * Equipment Rinse and Trip Blanks are aqueous samples and will be analyzed for VOCs only.
*** Site Target Lists include aromatic hydrocarbons and base/neutral/acid semivolatile fractions including pyridine, amended to include additional parameters based on the analytical results of the background and worst case soils from the two large SWMUs.

TABLE 6 - 1

INSTRUMENT CALIBRATION

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS-volatiles	SW-846 (8260)	5	%RSD <30% (CCC) 1,1-dichloroethene; chloroform 1,2-dichloropropane; toluene ethyl benzene; vinyl chloride RF> 0.30 (SPCC) chloromethane; 1,1-dichloroethane; bromoform (0.25); 1,1,2,2-tetrachloroethene; chlorobenzene	As needed	As needed	20%D	Every 12 hr.	CCC %D <25%. Same SPCC criteria as initial calibration

TABLE 6 - 1

INSTRUMENT CALIBRATION

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification	Acceptance/ Rejection Criteria Continuing Calibration Verification
GC/MS-semi-volatiles	SW846-8270	5	% RSD <30% (CCC) acenaphthene 1,4-dichlorobenzene hexachlorobutadiene N-nitroso-diphenylamine di-octylphthalate fluoranthene benzo(a)pyrene 4-chloro-3-methylphenol 2,4-dichlorophenol 2-nitrophenol phenol pentachlorophenol 2,4,6-trichlorophenol RF>0.05(SPCC) N-nitroso-di-n-propylamine hexachlorocyclopentadiene 2,4-dinitrophenol 4-nitrophenol	% RSD for each non-CCC of interest must be ≤ 40%	As needed	20%D	Every 12 hours	CCC %D <30%. Same SPCC criteria as initial cal.

TABLE 6-1

INSTRUMENT CALIBRATION

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification	Acceptance/ Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification	Acceptance/ Rejection Criteria Continuing Calibration Verification
Flame AA	SW-846	4	Correlation coefficient must be ≥0.995	At least daily, or as required (when CCV fails acceptance criteria).	Every calibration	90-110%R	Every 10 samples	90-110%R
Cold Vapor AA	SW-846	4	Correlation coefficient must be ≥0.995			80-120%R		80-120%R
ICP	SW-846	1	Not Applicable			90-110%R		90-110%R
Graphite Furnace AA	SW-846	4	Correlation coefficient must be ≥0.995			90-110%		90-110%

TABLE 7 - 1
ANALYTICAL METHODS AND DETECTION LIMITS

SOIL MATRIX

Parameter	SOP Name	Equivalent EPA Method	Detection Limit
USEPA Volatiles	Standard Operating Procedure for Modified Methods 8240 and 624.	8240	Table 7-3
USEPA Semivolatiles	Standard Operating Procedure for Modified Methods 8270 and 625	8270, 3550 Extraction	Table 7-3
Arsenic	Arsenic-Graphite Furnace Atomic Absorption Spectroscopy	7060, 3050 Digestion	0.10 mg/kg
Barium	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	0.40 mg/kg
Cadmium	Cadmium-Direct Aspiration Atomic Absorption Spectroscopy	7130, 3050 Digestion	0.04 mg/kg
Cadmium	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	0.04 mg/kg
Chromium	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	1.6 mg/kg
Copper	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	0.60 mg/kg
Lead	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	1.0 mg/kg

TABLE 7 - 1

ANALYTICAL METHODS AND DETECTION LIMITS

SOIL MATRIX

Parameter	SOP Name	Equivalent EPA Method	Detection Limit
Mercury	Mercury Analysis of Soils, Sludges and Wastes by Manual Cold Vapor Technique	7471, Prep Method in 7471	0.10 mg/kg
Selenium	Selenium-Graphite Furnace Atomic Absorption Spectroscopy	7740, 3050 Digestion	0.50 mg/kg
Silver	Silver-Direct Aspiration Atomic Absorption Spectroscopy	7760, 3050 Digestion	0.20 mg/kg
Silver	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	0.20 mg/kg
Zinc	Inductively Coupled Plasma Atomic Emission Spectroscopy	6010, 3050 Digestion	0.40 mg/kg
Percent Solids	% Total Solids, Gravimetric	160.3	0.1%

TABLE 7 - 2

SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

				Hold Times	
Matrix	***Parameter***	***Container***	***Preservation***	***Extraction***	***Analysis***
Water	Volatile Organics	2 x 40 ml Glass Septa Vial	HCl to pH <2 Cool to 4^{o}C	---	14 days
Water	Semi-Volatile Organics	3 x 1 liter Amber Glass	Cool to 4^{o}C	7 days	40 days
Soil	Volatile Organics	125 ml Glass Septa Vial	Cool to 4^{o}C	---	14 days
Soil	Semi-Volatile Organics	500 ml Amber Glass	Cool to 4^{o}C	14 days	40 days
Water	Metals (Except Hg)	500 ml plastic or glass	pH <2 HNO_3	---	6 months
Water	Mercury	250 ml plastic or glass	pH <2 HNO_3	---	28 days
Soil	Metals (Except Hg)	8 oz wide mouth	---	---	6 months
Soil	Mercury	8 oz wide mouth	---	---	28 days

All sample containers are purchased precleaned and certified as Level II by I-CHEM Inc.

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Volatile Organic Compounds (82		
Acetone	50	0.10
Acetonitrile	10	0.10
Acrolein	5	0.01
Acrylonitrile	1	0.01
Benzene	1	0.01
Bromodichloromethane	1	0.01
Bromoform	1	0.01
Bromomethane	1	0.01
2-Butanone (MEK)	50	0.10
Carbon disulfide	50	0.10
Carbon tetrachloride	1	0.01
Chlorobenzene	1	0.01
2-Chloro-1,3-butadiene (Chloroprene)	5	0.01
Chloroethane	1	0.01
Chloroform	1	0.01
Chloromethane	1	0.01
3-Chloropropene (Allyl chloride)	10	0.01
Dibromochloromethane	1	0.01
1,2-Dibromo-3-chloropropane	1	0.01
1,2-Dibromoethane (Ethylene Dibromide)	1	0.01
Dibromomethane	5	0.01

Acetonitrile & acrolein may not perform well. ~~Maybe~~ should include in MS soln.

Ditto for acrylonitrile

[1] Detection limits may be elevated due to matrix interference. The listed values are consistent with Michigan Act 307 recommended method detection limits as specified in MERA Memorandum #14, Rev. 1, June 21, 1994

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Volatile Organic Compounds (8260)		
trans-1,4-Dichloro-2-butene	5	0.01
Dichlorodifluoromethane	1	0.01
1,2-Dichlorobenzene	1	0.01
1,3-Dichlorobenzene	1	0.01
1,4-Dichlorobenzene	1	0.01
1,1-Dichloroethane	1	0.01
1,2-Dichloroethane	1	0.01
1,1-Dichloroethylene	1	0.01
cis-1,2-Dichlorethylene	1	0.01
trans-1,2-Dichloroethylene	1	0.01
Dichloromethane (Methylene Chloride)	1	0.01
1,2-Dichloropropane	1	0.01
cis-1,3-Dichloropropene	1	0.01
trans-1,3-Dichloropropene	1	0.01
1,4-Dioxane	50	0.10
Ethylbenzene	1	0.01
2-Hexanone	50	0.10
Iodomethane	5	0.01
Methacrylonitrile	50	0.10
4-Methyl-2-pentanone (MIBK)	50	0.10
2-Methyl-1-propanol (Iso-butyl alcohol)	500	1.0
Propionitrile	50	0.10
Styrene	1	0.01
1,1,1,2-Tetrachloroethane	1	0.01
1,1,2,2-Tetrachloroethane	1	0.01
Tetrachloroethylene	1	0.01
Toluene	1	0.01

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Volatile Organic Compounds (8260)		
1,1,1-Trichloroethane	1	0.01
1,1,2-Trichloroethane	1	0.01
Trichloroethylene	1	0.01
Trichlorofluoromethane	1	001
1,2,3-Trichloropropane	1	0.01
Vinyl acetate	50	0.10
Vinyl chloride	1	0.01
Xylene (Total)	3	0.03
Semi-Volatile Organic Compounds (8270)		
Acenaphthene	5	0.330
Acenaphthylene	5	0.330
Acetophenone	10	0.330
2-Acetylaminofluorene	50	2.0
4-Aminobiphenyl	10	0.330
Aniline	5	1.7
Anthracene	5	0.330
Aramite	50	2.0
Benzo(a)anthracene	5	0.330
Benzo(b&k)fluoranthene	5	0.330
Benzo(g,h,i)perylene	5	0.330
Benzo(a)pyrene	5	0.330
Benzyl alcohol	50	1.3
Bis(2-chloroethoxy)methane	5	0.330
Bis(2-chloroethyl)ether	5	0.330
Bis(2-chloroisopropyl)ether	5	0.330

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Semi-Volatile Organic Compounds (8270)		
Bis(2-ethylhexyl)phthalate	5	0.330
4-Bromophenyl phenyl ether	5	0.330
Butyl benzyl phthalate	5	0.330
2-sec-Butyl-4,6-dinitrophenol	5	2.0
p-Chloroaniline	20	1.3
4-Chloro-3-methylphenol	5	0.330
2-Chloronaphthalene	5	0.330
2-Chlorophenol	5	0.330
4-Chlorophenyl phenyl ether	5	0.330
Chrysene	5	0.330
Dibenzo(a,h)anthracene	5	0.330
Dibenzofuran	5	0.330
Di-n-butyl phthalate	5	0.330
3,3'-Dichlorobenzidine	20	2.0
2,4-Dichlorophenol	5	0.330
Diethylphthalate	5	0.330
p-(Dimethylamino)azobenzene	10	0.330
7.12-Dimethyl benz(a)anthracene	10	0.330
3,3'-Dimethylbenzidine	50	2.0
2,2-Dimethylphenethylamine	20	0.70
2,4-Dimethylphenol	5	0.330
Dimethylphthalate	5	0.330
1,3-Dinitrobenzene	5	0.330
4,6-Dinitro-2-methylphenol	20	1.7
2,4-Dinitrophenol	20	1.7
2,4-Dinitrotoluene	5	0.330
2,6-Dinitrotoluene	5	0.330

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Semi-Volatile Organic Compounds (8270)		
Di-n-octylphthalate	5	0.330
Diphenylamine	10	0.330
Ethylmethacrylate	50	2.0
Ethyl methanesulfonate	10	1.0
Fluoranthene	5	0.330
Fluorene	5	0.330
Hexachlorobenzene	5	0.330
Hexachlorobutadiene	5	0.330
Hexachlorocyclopentadiene	5	0.330
Hexachloroethane	5	0.330
Hexachlorophene	*	*
Hexachloropropene	50	2.0
Indeno (1,2,3-cd)pyrene	5	0.330
Isophorone	5	0.330
Isosafrole	20	0.70
Methapyrilene	10	1.0
3-Methylcholanthrene	50	2.0
Methylmethacrylate	50	2.0
Methyl methane sulfonate	50	2.0
2-Methylnaphthalene	5	0.330
2-Methylphenol	5	0.330
3-Methylphenol	5	0.330
4-Methylphenol	5	0.330
Naphthalene	5	0.330
1,4-Naphthoquinone	1000	30
1-Naphthylamine	50	2.0

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Semi-Volatile Organic Compounds (8270)		
2-Naphthylamine	50	2.0
2-Nitroaniline	20	1.7
3-Nitroaniline	20	1.7
4-Nitroaniline	20	1.7
Nitrobenzene	5	0.330
2-Nitrophenol	5	0.330
4-Nitrophenol	20	1.7
4-Nitroquinoline-1-oxide	500	20
N-Nitrosodi-n-butylamine	20	0.90
N-Nitrosodiethylamine	50	2.0
N-Nitrosodimethylamine	5	0.330
N-Nitrosodiphenylamine	5	0.330
N-Nitrosodi-n-propylamine	5	0.330
N-Nitrosomethylethylamine	50	2.0
N-Nitrosomorpholine	20	0.70
N-Nitrosopiperidine	20	0.70
N-Nitrosopyrrolidine	20	0.70
N-Nitro-o-toluidine	10	0.330
Pentachlorobenzene	5	0.330
Pentachloroethane	50	2.0
Pentachloronitrobenzene	20	0.50
Pentachlorophenol	1	1.7
Phenacetin	10	0.330
Phenanthrene	5	0.330
Phenol	5	0.330
p-Phenylenediamine	*	*
2-Picoline	20	0.70

TABLE 7 - 3

ORGANIC PARAMETERS AND DETECTION LIMITS[1]

	Water (ug/l)	Soil (mg/kg)
Semi-Volatile Organic Compounds (8270)		
Pronamide	10	0.330
Pyrene	5	0.330
Pyridine	10	0.330
Safrole	10	0.330
1,2,4,5-Tetrachlorobenzene	10	0.50
2,3,4,6-Tetrachlorophenol	50	2.0
o-Toluidine	10	0.330
1,2,4-Trichlorobenzene	5	0.330
2,4,5-Trichlorophenol	50	1.7
2,4,6-Trichlorophenol	5	0.330
sym-Trinitrobenzene	20	0.70

*These compounds have been demonstrated to be difficult to extract from water.

Notes:

(1) Detection Limits are highly matrix dependent. The above values are intended for guidance and may not be technically achievable.

TABLE 8 - 1

METHOD SPECIFIC DATA QUALITY OBJECTIVES
MATRIX SPIKE AND DUPLICATE CONTROL LIMITS

	Soil Matrix		Water Matrix	
Parameter	**Precision**	**Accuracy**	**Precision**	**Accuracy**
1,1-Dichloroethylene	22%	64-143%	25%	63-140%
Trichloroethylene	24%	68-132%	22%	66-128%
Chlorobenzene	20%	68-126%	22%	67-125%
Toluene	18%	73-134%	22%	70-129%
Benzene	20%	70-128%	21%	68-128%
1,2,4-Trichlorobenzene	25%	27-108%	17%	34-113%
Acenaphthene	22%	34-103%	21%	33-113%
2,4-Dinitrotoluene	21%	38-110%	20%	33-122%
Pyrene	21%	40-119%	22%	33-133%
N-Nitroso-di-n-propylamine	29%	31-121%	22%	40-125%
1,4-Dichlorobenzene	35%	16-111%	26%	33-109%
Pentachlorophenol	36%	1-120%	41%	21-137%
Phenol	29%	21-114%	39%	5-66%
2-Chlorophenol	27%	27-105%	31%	30-109%
4-Chloro-3-methylphenol	20%	39-113%	20%	36-115%
4-Nitrophenol	33%	20-124%	53%	3-73%

TABLE 8 - 2

METHOD SPECIFIC DATA QUALITY OBJECTIVES SURROGATE COMPOUND PERCENT RECOVERY CONTROL LIMITS[2]

Method	Parameter	Soil	Water
8260	4-Bromofluorobenzene	71-113	87-108
8260	Dibromofluoromethane	84-122	89-118
8260	Toluene-d_8	84-110	87-111
8270	Nitrobenzene-d_5	21-100	41-99
8270	2-Fluorobiphenyl	36-102	34-109
8270	o-Terphenyl	27-117	34-128
8270	Phenol-d_6	20-95	5-50
8270	2-Fluorophenol	25-89	12-72
8270	2,4,6-Tribromophenol	23-110	31-118

---

[2] Control Limits are subject to change and are updated every 4-6 months.

TABLE 10 - 1

TriMatrix ANALYTICAL SERVICES

Internal Laboratory Audit Record

Sample Receiving/Log-in

Audit Date: ______________

Auditor: ______________

Item/ Description	Yes	No
Are training records maintained and up to date?		
Are SOP's for sample receiving and sample log-in documented and where are they located?		
Is the pH checked on all chemically preserved samples and recorded correctly?		
Are cooler temperatures checked for each set of samples received and documented on the pH/Temp log form?		
Are excursions in cooler temperatures and chemical preservations properly noted?		
Do COC forms accompany each submittal of samples?		
Are volatile samples logged in expeditiously?		
Are volatile water samples stored separate from soils and wastes?		
Are temperatures monitored daily for each storage refrigerator and is the thermometer immersed in a liquid?		

TABLE 10 - 1

TriMatrix ANALYTICAL SERVICES

Internal Laboratory Audit Record

Sample Receiving/Log-in

Audit Date: ____________

Auditor: ____________

Item/ Description	Yes	No
Are temperature excursions and corrective actions noted in the temperature log book?		
Is each lot of pH test strips checked for accuracy against known standards?		
Are chemical preservatives monitored for purity?		

TABLE 10 - 1
TriMatrix ANALYTICAL SERVICES
Internal Laboratory Audit Record
GC/MS Laboratory

Audit Date: ____________
Auditor: ____________

Item/ Description	Yes	No
Are training records maintained and up to date?		
Have MDL studies been performed for each analyte, anaytical technique and instrument?		
Have MDL studies been updated within the last 12 months?		
Are stock standard numbers assigned and recorded in a stock standard log book?		
Are working standards assigned and recorded in a working standard log book?		
Are instrument maintenance activities recorded in a maintenance log for each instrument?		
Are preventative maintenance procedures performed as recommended by the instrument manufacturer?		
Are all reagents properly labeled with date of receipt or formulation, record number date opened and expiration date?		
Are manufactures operating manuals available to the analysts?		
Are other log books, i.e. balance, pipet etc., available and in use in this area?		

TABLE 10 - 1

TriMatrix ANALYTICAL SERVICES

Internal Laboratory Audit Record

GC/MS Laboratory

Audit Date: ______________

Auditor: ______________

Item/ Description	Yes	No
Are all raw data printouts initialed at the time of review?		
Are instrument conditions documented for each analytical run?		
Are all benchsheets and related records, neat and maintained in an orderly manner?		
Has the area supervisor reviewed and initialed all record books for their laboratory area?		
Are laboratory control samples (LCS's) and method preparation blanks (MPB's) analyzed with each batch of samples?		
Are initial and continuing calibrations performed as outlined in the analytical methods?		
Are laboratory established control windows utilized for the monitoring of both method and matrix QC?		
Are corrective actions documented when QC's fail to meet establish acceptance criteria?		
Are analyst notebooks maintained by each analyst for this lab area?		

TABLE 10 - 1

TriMatrix ANALYTICAL SERVICES

Internal Laboratory Audit Record

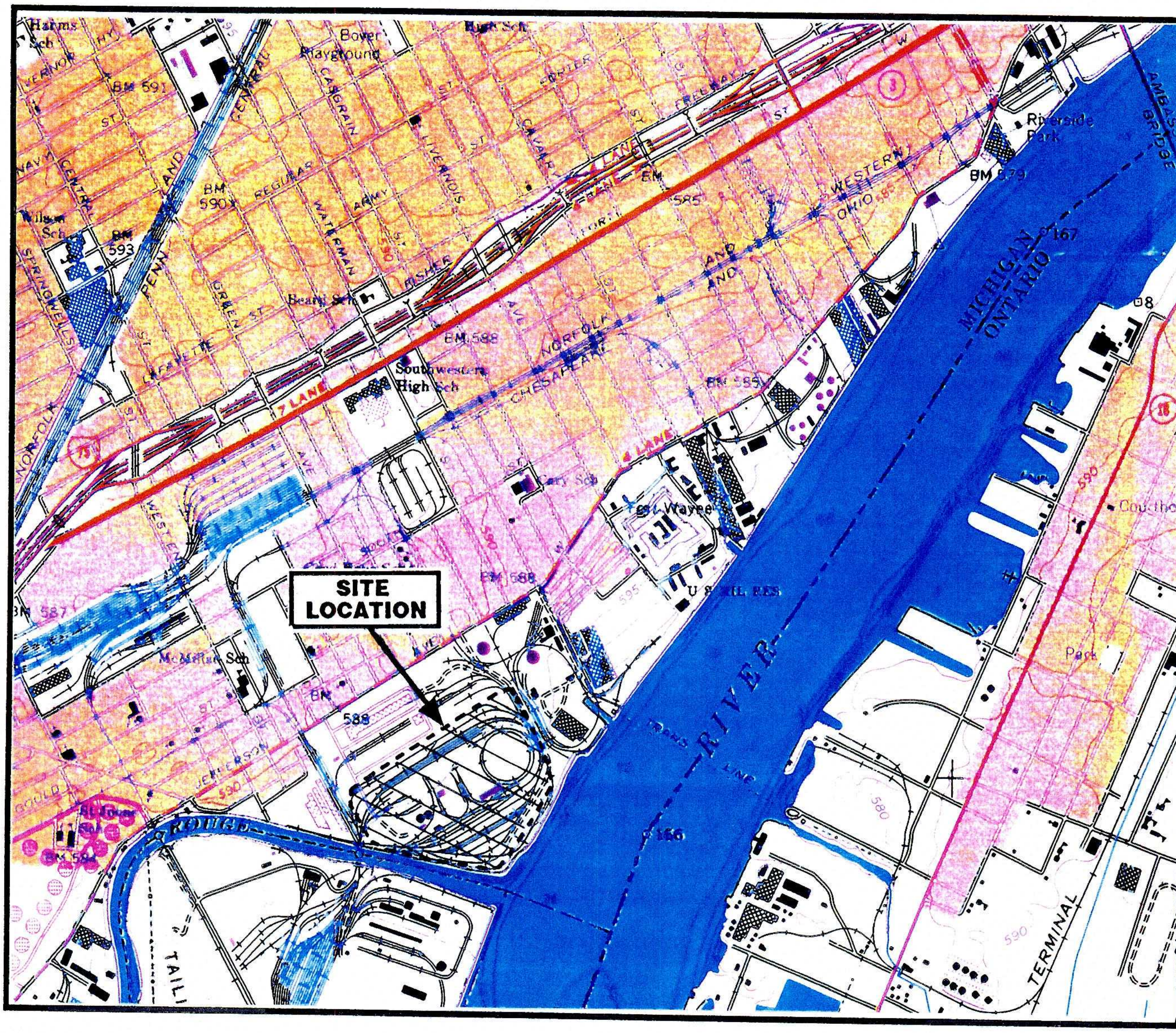
GC/MS Laboratory

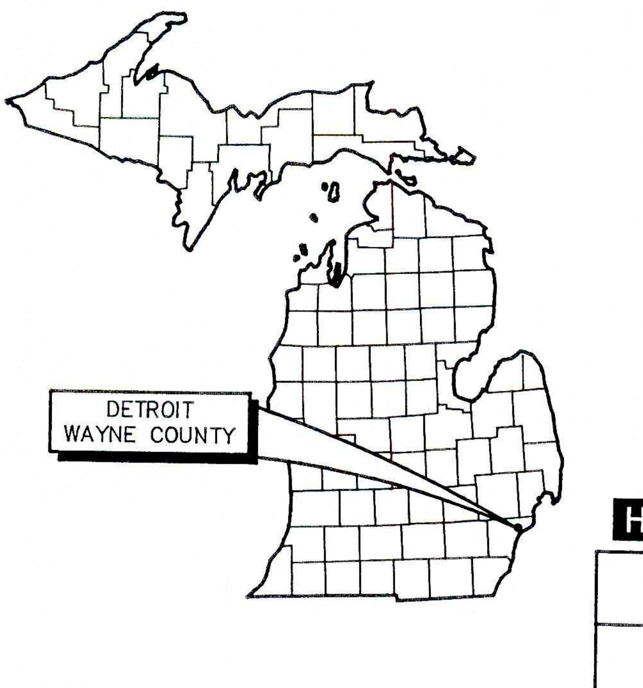
Audit Date: ____________

Auditor: ____________

Item/ Description	Yes	No
Are surrogates used in all analytical procedures for this lab area?		
Are corrective actions well documented when surrogate compounds fall outside established windows?		
Are CCC's and SPCC's within established method control limits on a daily basis?		
Are corrective actions adequate when an internal standard is out of control?		
Are the frequency of calibrations and instrument tuning adequate?		
Are QC samples performed at the appropriate frequency as outlined in the analytical SOP and QA manual?		
Are the correct qualifiers and procedures used to qualify data points that fall outside established control limits?		
Are permanent records maintained for all raw data printouts and electronic files?		
Is the data review process adequate to reveal any anomalies or errors in the analytical process?		

DCC-SLM/SEP0795





NORTH

HORIZON ENVIRONMENTAL

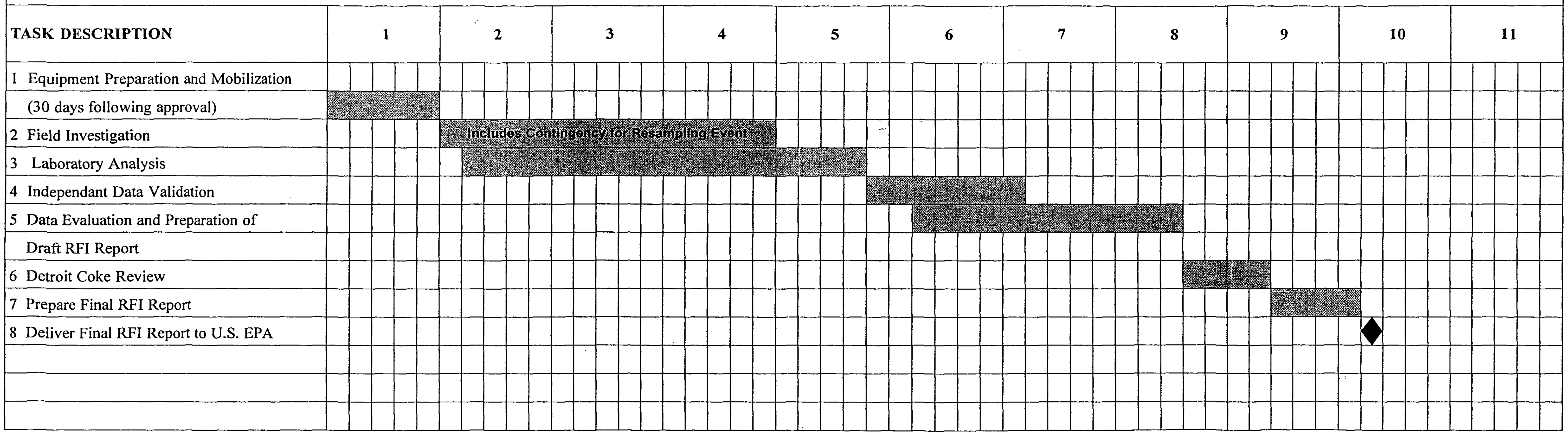
DETROIT COKE CORPORATION DETROIT, MICHIGAN	PROJECT NUMBER: DCC-0101
SITE LOCATION MAP	*FIGURE:* **1-1** SEPTEMBER, 1995

Figure 1-2
PROJECT SCHEDULE
DETROIT COKE CORPORATION
RCRA CORRECTIVE ACTION
RCRA Facility Investigation

Prepared by Horizon Environmental (January 1996; Rev. 0)

RCRA Facility Investigation

MONTHS FOLLOWING APPROVAL



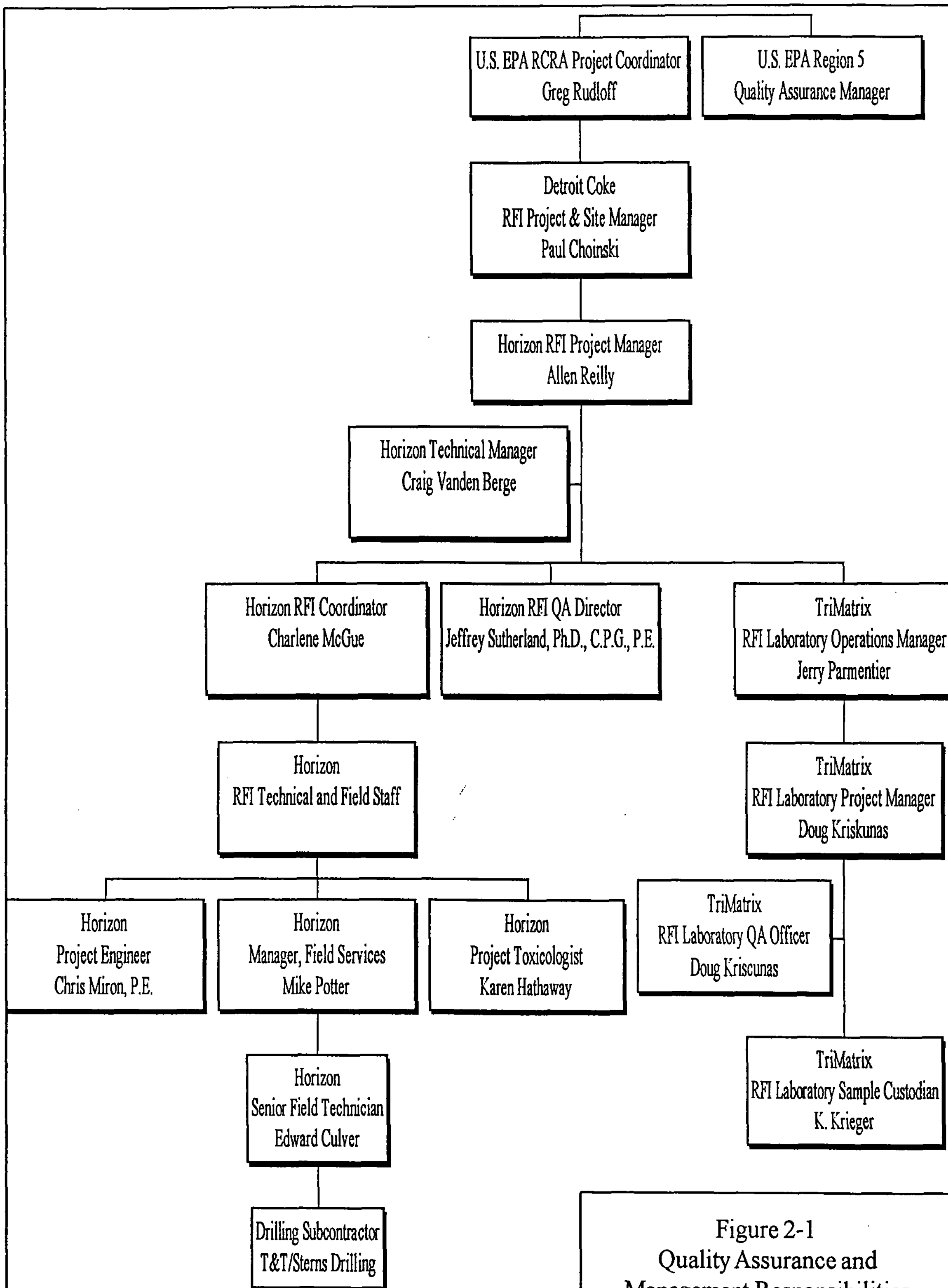


Figure 2-1
Quality Assurance and
Management Responsibilities

Detroit Coke
Detroit, Michigan

January 1996 DET 0104

Appendix B

Field Sampling SOPs

Field Notes/Records
Elevation Surveys for Monitor Wells
Monitoring Well Sampling with a Bailer
Soils Classification
Split Spoon Sampling
Temporary Wells Through Hollow-Stem Augers
Water Level Measurement
Well/Boring Log Guidelines
Well Casing Volume Calculation
Field QC Sample Guidelines
Field Decontamination, Down Hole Sampling Equipment
Jar Head Space Measurements in Unsaturated Soil Samples
Soil Boring Drilling Using Hollow Stem Augers
Packing and Shipping Samples for Laboratory Analysis
Field Determination of pH
Field Determination of Conductivity, Method 205
Soil and Ground Water Sampling Using the Geoprobe
Permanent Wells Installed Through Hollow Stem Augers
Standard Photoionization Detector (PID) Operations and Procedures

Field SOP

Field Notes/Records

FIELD NOTES/RECORDS

Field notes must be copied to the Project Manager, or the Project Engineer/Geologist when the project schedule dictates. Don't invest time in editing or rewriting them; the notes should have been taken throughout the day and, therefore, they should be a sufficiently accurate record in their original form.

By providing the field notes in a timely manner, the Project Manager will have the field information and can begin to get any of his questions about the notes answered right away.

NOTES MUST INCLUDE:

1. Project Name
2. Project Number
3. Originator's Name
4. Date
5. Location of Field Activity
6. Materials and Equipment
7. Weather - limited information (sunny, overcast, humid, precipitation, wind, approximate temperature)
8. Methods, Brief - "according to work plan". If deviation from plan, you must note what was done differently, why, and the results. You must note whether the deviation was called for by you, or a departure by the contractor. If by the contractor, whether you have approved or disapproved it.
9. Problems Encountered - how they were dealt with. Problems include equipment malfunction, delays, unsafe working conditions or procedures, departure from the Health & Safety Plan, attitudes/comments of workers/visitors, weather adversely affecting the work, and inspected work found to be unsatisfactory. Include a sketch of an unusual procedure, if helpful.

10. Site Visitors - who and when, their comments.

11. Location Descriptions - wells, borings, and sampling stations. Distance tie-in to two fixed site facilities.

12. Summary of Work Accomplished.

Notes must reference any forms used for documenting calculations, location descriptions, depth measurements, and time and materials.

Field SOP

Elevation Surveys for Monitor Wells

ELEVATION SURVEYS FOR MONITOR WELLS

EQUIPMENT LIST

- standard surveyors level
- two persons
- well lock keys
- survey forms
- calculator
- stadia rod
- hand-held tape in 0.01-foot increments
- tools to open well caps
- tripod

JOB DESCRIPTION

Obtain survey elevations for wells.

EXPECTATIONS

- Shoot and record well elevations at the ***top of casing***.
- Shoot and record ground elevation at each well location.
- Tie all loops together and to reference datum.

The data generated from the survey is used to obtain accurate elevations which are necessary to gain a common reference point from which groundwater elevations, well screen elevations, cross-section maps, elevation contour maps, and more can be generated and compared to each other.

Before going into the field, decide with the person who has requested the work what the reference point should be. If the reference point is to be taken from a U.S.G.S. datum, it is necessary to know exactly where that benchmark is before beginning the survey. If a relative datum (e.g., 100.00 feet) is used, choose a benchmark that is a part of a permanent structure. Accurately detail the location chosen so that results may be duplicated in the future if necessary. An example of a good permanent benchmark may be a specific corner of a concrete foundation of a specific building, or a specific point on a fire hydrant.

The basic procedure is (refer to Example 1):

1. Begin the survey by recording the elevation and location of the reference point.

2. Set up the tripod and surveyor's level at the first station and level the instrument. Check instrument level by rotating 180^{o}; relevel if necessary.

3. Have one party hold the stadia rod on the reference point after the level and tri-pod have been set up.

4. Record the elevation shot in the +S column. By adding the +S to the known elevation, the height of the instrument (HI) will be determined:

   Elevation + S = HI

5. The rod man moves in the general direction of the well location and chooses a good turning point. The turning point must be well defined and solid, such as a rock, tree, root, or the top of a screw driver driven solidly into the ground.

6. Record the reading at the turning point as a -S on the form. The -S reading is subtracted from the HI to give the elevation of the turning point:

   HI - S = Elevation at Turning Point (TP)

7. The instrument man now moves the tri-pod and level in the general direction of the well.

8. The new reading is recorded as a +S.

   Elevation at TP + S = New HI

9. The procedure is repeated until a -S reading can be taken at each well top-of-casing and at each ground level at the well.

10. It may be necessary to use several turning points and loops to obtain all the data required. Be sure they are all tied together.

11. Once all the elevations have been recorded, close the loop. The rod man and instrument man proceed as before back to the original reference point. The loop is closed when the rod man returns to the original point of reference and that elevation is again recorded.

12. Clean the well cap threads with a wire brush and lubricate with teflon paste or beeswax before replacing.

13. Refer to the elevation survey illustration for a simple example.

ACCURACY

Each elevation measurement must be recorded to the nearest 0.01 foot. An elevation survey is of acceptable accuracy if the beginning and final elevation are within ± 0.03 feet.

Check the work when the survey is complete. Make sure the locations of the benchmarks are described in detail. Describe any difficulties which may have had an effect on the data. Turn in the paperwork when it is completed and legible to the person who requested it. Keep records for personal files.

METHOD REQUIREMENTS

- If the rod cannot be positioned at the TOC, measure and record the elevation difference from TOC to the point where the rod was positioned.

- Rock the stadia rod toward and away from the instrument man at each location. The instrument man should record the lowest elevation reading as the rod is rocking. The lowest reading indicates when the rod is straight up and down.

- Use the top of casings (TOC's) as turning points. If this can be done, it will be possible to mathematically verify the results from the office.

IMPORTANT TERMS

BENCHMARK (BM):

A definite point of known or assumed elevation not subject to change. Permanent benchmarks have been established throughout the United States by the U.S. Coast and Geodetic Survey and the U.S. Geologic Survey (U.S.G.S.). Benchmarks are used as starting points for surveys requiring a common reference point.

SURVEY FIELD NOTES:

The record of the work performed. Typical entries should be:

- date
- description of weather
- names of individuals in the party and their responsibilities
- the instrument and methods being used

LEVEL NOTES:

The standard form for recording stations and elevations taken (see example).

PLUS SIGHT (+S):

A rod reading taken on a point of known or assumed elevation. The plus sight added to the elevation at the point gives the height of the instrument.

MINUS SIGHT (-S):

A rod reading taken on a point where elevation is to be determined. HI - S = the elevation of the point.

HEIGHT OF INSTRUMENT (HI):

The elevation of the line of sight when the instrument is level.

TURNING POINT (TP):

A solid, well-defined point on which the rod is set while the instrument is being moved from one location to another. A minus sight is taken on a TP from the first level set-up to determine its elevation. A plus sight (+S) is taken on a TP from the second set-up to determine the new height of the instrument.

TOP OF CASING (TOC):

The top of casing or top of threads is the uppermost point of the well casing.

MONITORING WELL PURGE AND SAMPLING WITH A BAILER

The objective in well sampling is to obtain a representative sample of the ground water from the formation where the well screen has been placed.

JOB DESCRIPTION:

Obtain ground water samples from the specified wells.

TASK-SPECIFIC EQUIPMENT AND MINIMUM INFORMATION NEEDED:

- detailed well location map
- order of the well sampling
- previous water level data
- disposable gloves
- sample bottles
- calculator
- $V = Hr^2 (0.163)$[a]
- water level tape (electric or steel)
- well pumps if necessary
- polypropylene rope
- bailers
- container for purge water (if required)
- well keys
- total well depth data
- interface probe (Solinist Model 121 or equivalent)

[a]Refer to guideline for calculating the volume of standing water in a well casing.

OR alternatively if the filter pack volume is to be considered: r = auger O.D./2 in inches.

EXPECTATIONS:

All wells will be inspected for free product (LNAPL and DNAPL) prior to purging.

If LNAPL is present, its thickness will be measured within 1/100 of a foot.

All water levels will be taken prior to sampling.

All purge volume data will be recorded.

Standard decontamination procedures will be followed.

Noticeable discoloration or odor in the water will be reported.

Each sample requested will be collected.

PROCEDURES:

1. All the wells of a cluster to be sampled are uncapped. Care must be taken not to mix the caps up. The caps should be placed near the well on a clean area, such as a small piece of plastic. Inspect the condition of the well(s).

2. Take a round of water levels.

3. Consult the field sampling plan for purging reqirements. Calculate and record the volume of water in the casing, with or without the filter pack volume, depending on the filed sampling plan. Record the needed purge volume; typically, this is three times the volume of water in the casing and filter pack or casing alone.

4. Purge the well with a clean or dedicated bailer and a new length of polypropylene rope. Concentrate the purging effort at the air/water interface.

5. Record the amount of water actually purged and what was done with the purge water. Record the method of purging, and the type of bailer used (Teflon or stainless steel).

6. Collect the ground water sample with the bailer.

7. Fill the sample container accordingly.

8. Seal the container.

9. If the container is a VOC vial, fill the vial completely until a convex meniscus is formed at the top of the vial and cap quickly so that the vial contains no headspace. Turn the full container upside down and tap it lightly. Watch for air bubbles. If air is present in the bottle, discard and resample the well.

10. Label the sample bottle(s) and place in a cooler with ice for transport to the laboratory.

11. Follow standard decontamination procedures if bailer is to be re-used.

12. Dispose of the used rope.

In wells which do not readily recover, it may be impractical to purge three well casing volumes prior to sampling. In these cases, a field judgment must be made as to what is a "reasonable" amount of time to spend in securing the sample. In a well that can be bailed dry, it is acceptable to purge one casing volume, wait for the well to recover, and take a sample. Keep good records of the volume of water actually purged and estimate the recovery time for the well. The purpose of purging is to remove all the static water from the well. In a well which is bailed dry, that objective is obtained after one well casing volume is removed.

Field SOP

Monitoring Well Sampling With A Bailer

MONITORING WELL PURGE AND SAMPLING WITH A BAILER

The objective in well sampling is to obtain a representative sample of the ground water from the formation where the well screen has been placed.

JOB DESCRIPTION:

Obtain ground water samples from the specified wells.

TASK-SPECIFIC EQUIPMENT AND MINIMUM INFORMATION NEEDED:

- detailed well location map
- order of the well sampling
- previous water level data
- disposable gloves
- sample bottles
- calculator
- $V = Hr^2 (0.163)^a$
- water level tape (electric or steel)
- well pumps if necessary
- polypropylene rope
- bailers
- container for purge water (if required)
- well keys
- total well depth data

[a]Refer to guideline for calculating the volume of standing water in a well casing.

OR alternatively if the filter pack volume is to be considered: r = auger O.D./2 in inches.

EXPECTATIONS:

All water levels will be taken prior to sampling.

All purge volume data will be recorded.

Standard decontamination procedures will be followed.

Noticeable discoloration or odor in the water will be reported.

Each sample requested will be collected.

PROCEDURES:

1. All the wells of a cluster to be sampled are uncapped. Care must be taken not to mix the caps up. The caps should be placed near the well on a clean area, such as a small piece of plastic. Inspect the condition of the well(s).

2. Take a round of water levels.

3. Consult the field sampling plan for purging reqirements. Calculate and record the volume of water in the casing, with or without the filter pack volume, depending on the filed sampling plan. Record the needed purge volume; typically, this is three times the volume of water in the casing and filter pack or casing alone.

4. Purge the well with a clean or dedicated bailer and a new length of polypropylene rope. Concentrate the purging effort at the air/water interface.

5. Record the amount of water actually purged and what was done with the purge water. Record the method of purging, and the type of bailer used (Teflon or stainless steel).

6. Collect the ground water sample with the bailer.

7. Fill the sample container accordingly.

8. Seal the container.

9. If the container is a VOC vial, fill the vial completely until a convex meniscus is formed at the top of the vial and cap quickly so that the vial contains no headspace. Turn the full container upside down and tap it lightly. Watch for air bubbles. If air is present in the bottle, discard and resample the well.

10. Label the sample bottle(s) and place in a cooler with ice for transport to the laboratory.

11. Follow standard decontamination procedures if bailer is to be re-used.

12. Dispose of the used rope.

In wells which do not readily recover, it may be impractical to purge three well casing volumes prior to sampling. In these cases, a field judgment must be made as to what is a "reasonable" amount of time to spend in securing the sample. In a well that can be bailed dry, it is acceptable to purge one casing volume, wait for the well to recover, and take a sample. Keep good records of the volume of water actually purged and estimate the recovery time for the well. The purpose of purging is to remove all the static water from the well. In a well which is bailed dry, that objective is obtained after one well casing volume is removed.

Field SOP

Soils Classification

SOILS CLASSIFICATION

There are several different soil classification systems. In order to maintain a level of consistency and conformity with widespread practices, we have adopted the Unified Soils Classification System (USCS). Use of the generalized symbols of the USCS facilitates soil correlation's and the production of geologic cross sections.

Most soil descriptions are written in the field based on visual and manual observations, but if a more accurate description is required, than the laboratory analyses that are required to definitively classify the soil sample according the USCS are a sieve analysis and the Atterberg limits.

There are four major soil divisions in the USCS:

1. Coarse grained,
2. Fine grained,
3. Organic soils, and
4. Peat

Soils too large to pass through a 75 mm sieve (about 3 inches) are considered "oversized" material according to this system. These "oversized" materials are boulders and cobbles.

Each soil description should follow this general order:

1. Texture
    a. basic
    b. modifying
2. Consistency
3. Color
4. Moisture content

After the moisture or water content of the soil has been described, further observations--such as odor, presence of roots or debris, or any other notable observations--are recorded.

Each of these items is described in more detail below.

1. Texture

a. Basic Texture

USCS Division	Basic Texture or Description to Use	Particle Diameter Size	Common Comparison
Oversized	Boulder	larger than 12 inches	
Soils	Cobble	3 to 12 inches	
Coarse grained	Coarse gravel	3/4 to 3 inches	
Soils	Fine gravel	4.75 mm to 3/4 inch	pea to large marble
	Coarse sand	2 to 4.75 mm	pepper to pea size
	Medium sand	.425 mm to 2 mm	pencil lead to pepper
	Fine sand	.075 to .425 mm	table sugar
Fine grained Soils	Silt	<.075 mm	powdered sugar
	Clay	<.075 mm	individual grains are not visible
Highly Organic	Peat	organic, fibrous or	
Soils		amorphous textured	
		vegetable tissue	
	Organics	defined as muck, coal, etc.	

Clay is distinguished from silt by plasticity. Silt is non plastic or very slightly plastic and exhibits little or no strength when air dry (plasticity index <4). Clay can be made to exhibit plasticity (putty-like properties) within a range of water content, and it exhibits considerable strength when air dry (plasticity index >4).

To distinguish clay from silt in a moist field sample, clay will ribbon down to a thickness of approximately 1/32 of an inch and can be molded into any shape. As the silt or sand content in a clay increases, so does the ribbon thickness and molding the sample becomes more difficult. A moist silt sample will ribbon to only 1/4 inch or greater in thickness and is more difficult to mold.

In wet soils, clay, when rubbed into the palm of a hand, is very difficult to rub off. Clay will hold its water content when shaken. When a wet silt dries in the hand, it can be rubbed off readily and a wet silt sample will puddle readily when shaken. See Attachments 1 and 2 for field guidance to distinguish silts from clays.

b. Modifying Texture

Estimates of the modifying texture are given using the following adjectives:

For sands and finer grained particles:

DescriptiveWord	Estimated Percentage
Trace	less than 10%
Little	10 to 30%
Some	30 to 45%
And	45 to 50%

For particles coarser than gravels (i.e., cobbles and boulders), the adjective "occasional" may be used to describe their percentage. An estimate of the maximum grain size should also be stated in the description for coarse gravel and larger grain sizes.

2. Consistency

The consistency of sands or gravels is described adequately by the blow counts required to drive the split-spoon sampler. Therefore, if the blow counts are recorded, the description of consistency may be omitted. For fine grained soils (i.e. clays), the description of consistency in addition to the recorded blow counts is more informative. For clay, use the following descriptions to define the consistency.

Description	Criteria
Very hard	Thumbnail will not dent
Hard	Thumb will not indent soil but readily indentedwith thumbnail
Firm	Thumb will indent soil about 1/4 inch
Soft	Thumb will penetrate soil about 1 inch
Very soft	Thumb will penetrate soil more than 1 inch

The consistency of clays can be defined in the laboratory by the results of the unconfined compression test.

Plasticity

Refer to Table 4 and especially the section on *toughness* for a practical approach to estimation of plasticity (consistency near plastic limit) in the field; and based on that, to assign "H" or "L" to cohesive organic samples.

3. Color

Color is useful in distinguishing soils similar in geologic origin and post-origin processes. Record the color of the soil as you see it. The color may be modified by an adjective (e.g. light brown). If there are two major but distinct colors in the soil, describe the color as mottled or variegated (e.g., gray mottled brown).

4. Moisture Content

Describe the water content of every soil type encountered. Three main adjectives to use are:

Water Content	Sample Characteristics
Dry	Powdery or hard
Moist	Plastic or containing some liquid
Wet	Saturated or puddles when shaken

Again, modifiers can be added to describe varying degrees of moisture content.

Once the soil boring is complete and all the soil types have been described, assign the appropriate USCS symbol to each soil description on the soil log so that similar soils can be clearly grouped together to represent the major soil layers present at the site (Tables 1, 2 and 3).

Examples:

Soil Description	USCS Symbol
SAND, fine to medium, some silt, trace clay, light brown, wet	SM
CLAY, some silt, trace medium to fine sand, soft, brown mottled gray, moist (trace rootlets)	ML/CL
SILT, trace fine sand, yellow-brown, dry	ML
SAND AND GRAVEL, brown, dry	SW/GW
CLAY, little silt, trace fine to medium sand, occasional cobble (6"), very hard, gray, slightly moist	CL
PEAT, brown, very soft, wet	PT
SILT, some clay, little organics, very soft, moist (decaying odor)	OL/OH

A borderline symbol is two symbols separated by a slash, for example OL/OH. A borderline symbol is used to indicate a soil that has been identified as having properties that do not distinctly place the soil into a specific group.

Each log should be accurate and detailed. The frequency of soil sampling should be reflected in the detail of the well/boring log. The log for a borehole sampled continuously will be much more detailed in both soil descriptions and depths than a log for the borehole in which no soil samples were collected.

Well/boring log forms must be completed for every well or boring installed, regardless of depth or method used, even if it has not been specifically requested.

References:

1991 Annual Book of ASTM Standards, Volume 04.08 D 2488-90 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

An Introduction to Geotechnical Engineering Robert D. Holtz, William D. Kovacs, Prentice-Hall Civil Engineering Mechanics Series

AGI Data Sheets, 3rd Edition Compiled by J.T. Dutro, Jr., R.V. Dietrich, R. M. Foose, American Geological Institute 1989, Data sheets 29.2 and 38.1

Earth Manual, A Water Resources Technical Publication, 2nd ed., U.S. Department of the Interior, United States Government Printing Office Washington 1974. Reprinted in 1980.

ATTACHMENT 1

Field Identification Procedures for Fine Grained Soils[1]

These procedures may be performed on the minus No. 40 sieve size particles, approximately 1/64 inch for field classification purposes; screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

DILATANCY: (Reaction to shaking)

Take a small amount of moist soil. Add enough water, if necessary, to make the soil soft but not sticky. Place the soil in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the soil which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the sample stiffens, and finally it cracks or crumbles.

The rapidity of the appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and the most distinct reaction whereas a plastic clay has no reaction. Inorganic silts show a moderately quick reaction.

DRY STRENGTH (Crushing characteristics)

Mold a small sample of soil to the consistency of putty, adding water if necessary. Allow the soil to dry completely by sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

TOUGHNESS (Consistency near plastic limit)

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[1] Earth Manual, A Water Resources Technical Publication, Second Edition, U. S. Department of the Interior, United States Government Printing Office Washington 1974, Reprinted in 1980

Mold a small sample to the consistency of putty adding water if necessary. If the sample becomes too sticky, spread the sample out in a thin layer and allow some of the soil moisture to evaporate. Roll the specimen out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation, the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces are lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil and the higher is the plasticity. Weakness of the thread at the plastic limit indicates either inorganic clay of low plasticity, or materials such as Kaolin-type clay and organic clays.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Field SOP

Split-Spoon Sampling

SPLIT-SPOON SAMPLING

Soil borings that are drilled for a geotechnical study (i.e., a study designed to determine the compressive strength of the soil for the purpose of new building construction) are usually sampled at 2.5-foot intervals in the first 10 feet below grade and at 5-foot intervals thereafter to the bottom of the boring.

The depths from which soil samples are collected in an environmental investigation can be very site-specific. Soil samples are often collected from depths most likely to show environmental impact based on an evaluation of the known or suspected contaminants, the characteristics of the soils, and other variables that may affect a particular site.

Collecting a soil sample with a split-spoon or split-barrel sampling device is a common technique used to determine the physical soil characteristics and soil quality. It is described by ASTM Method D-1586 and is summarized below.

JOB DESCRIPTION:

Obtain soil samples at specified intervals, and collect the soil for laboratory analyses.

TASK-SPECIFIC EQUIPMENT NEEDED:

- drilling and sampling devices
- tape for locating
- well/boring log sheets

EXPECTATIONS:

A well/boring log sheet will be accurately completed at each well or boring, according to Horizon's standard operating procedure "Well/Boring Log Guidelines", including blow counts, PID or FID response, soil descriptions, and other soil boring details.

The boring will be located by measurements and labeled on a site sketch or base map.

PROCEDURE:

1. Advance the boring to the desired sampling depth.
2. Attach the split-spoon sampling device to the bottom end of the drilling rods and gently lower it to the bottom of the borehole.
3. A 140-pound hammer free-falling a distance of 30 inches is used to drive the 2-inch O.D. split spoon 18 inches into the undisturbed soil below. Drive the 2-inch O.D. split-spoon sampler into the undisturbed soil ahead of the lead auger.
4. Record the number of blows required to drive the sampler for each 6-inch increment. If the soil is particularly hard and the blow counts are in excess of 100 blows per 6 inches, a split spoon may not be capable of obtaining the sample. Stop to keep from damaging the sampling device.
5. Bring the split spoon back to the ground surface after it has been driven over the sample interval.
6. Open the split spoon, using care to minimize the volatilization of organic constituents from the sample.
7. Field screen the sample if it is required, as expeditiously as possible after opening the split spoon.
8. Take samples that are collected for lab analyses from the mid to lower portions of the split spoon. Immediately place the soil that is most likely to be impacted (based on PID or FID response and visual observations of staining) into the appropriate sample bottles. Collect the samples to be analyzed for volatile organic compounds first. Collect the soil for semi-volatile analyses next, and collect soil for inorganic analyses last.
9. Place the samples in appropriate containers, using a clean tool and/or clean gloves.
10. Visually inspect the sample and describe it accurately and completely on the well/boring log sheet.

The upper portion of soil in the sampler can be disturbed or not representative of the sample interval targeted. This is because residual soils from within the auger stem may become entrained in the sample. The upper portion should be observed but field judgment should be used as to whether it is really representative of the sample interval. The upper portion should not be collected for lab analyses.

Field SOP

Temporary Wells through Hollow-Stem Augers

TEMPORARY WELLS THROUGH HOLLOW-STEM AUGERS

Temporary wells are used to obtain a representative ground water sample from a discreet depth when permanent well construction is not desired.

PROCEDURE:

1. Advance the augers to the depth for the bottom of the well screen.
2. Remove the drill plug.
3. Lower the decontaminated well assembly to the bottom of the borehole.
4. If necessary, sand pack the well screen with clean, coarse sand grade silica sand to 1 foot above the top of the screen. Retract the augers while adding the sandpack.
5. Develop the well until sediment-free water is produced or at least three casing volumes are removed.
6. Sample the well with a clean bailer.
7. Pull the well out of the borehole.
8. Follow standard procedures for grouting the borehole.

Field SOP

Water Level Measurements

WATER LEVEL MEASUREMENT

There are two devices that are acceptable for measuring water levels. These are a steel tape and water-soluble carpenter's chalk, and an electric tape. While the electric tape reports measurements to 0.01 foot, it is less accurate than the steel tape method; therefore, the steel tape method should be preferred over the electric tape.

For some applications, the electric tape is preferred. An electric tape gives an accurate measurement to the water and is less likely to cross contaminate between wells that are to be sampled. Since the electric tape barely touches the water, it is easier to decontaminate after a water level measurement is taken. Water levels are obtained more quickly than with a steel tape.

The steel tape and chalk method is very accurate. This method, however, is a little less desirable for measuring water levels on wells that are to be sampled. The steel tape method introduces chalk to the water, the tape becomes rusted, and it is necessary to submerge a small portion of the tape to obtain a correct measurement.

The standard procedure for taking a water level measurement, whether using an electric tape or steel tape and chalk, is basically the same.

JOB DESCRIPTION:

Obtain a round of water levels.

TASK-SPECIFIC EQUIPMENT AND MINIMUM INFORMATION NEEDED:

- steel water level tape or electric water level indicator
- water-soluble carpenter's chalk
- paper towels
- hand-held engineer's measuring tape
- well location map
- well keys
- previous water level or water elevation data

EXPECTATIONS:

Water levels will be taken at all the indicated wells and recorded to the nearest 0.01 foot.

Document the time, date, and the method of the measurement.

PROCEDURES FOR A STEEL TAPE AND CHALK:

1. Uncap all the wells of a cluster to be measured to allow the water levels to stabilize. Be sure to place the well caps on a clean area (use visqueen if necessary). Vented well caps should provide for minimum (essentially zero) time for water level stabilization.

2. Smear the graduated portion at the end of the tape with chalk.

3. Carefully lower the tape into the well until the chalked portion of the tape intersects the water in the well.

4. Advance the tape until the nearest one-foot increment of the tape is exactly even with the top-of-casing; record.

5. Recoil the tape from the well and read the water level measurement directly from the wetted portion of the tape; record.

6. Dry the tape with a paper towel and resmear it with chalk, and take a second, confirmation measurement; record.

7. Clean the tape before proceeding to the next well.

8. Replace the well cap.

PROCEDURES FOR AN ELECTRIC WATER LEVEL INDICATOR:

1. Uncap the wells.
2. Carefully lower the tape into the well.
3. The buzzer will sound as the probe hits the water. Once the buzzer has sounded, slowly pull the tape up until the buzzer turns off.
4. Read the measurement from the top-of-casing and record it.
5. Take a second measurement to confirm; record it.
6. Clean the tape before proceeding to the next well.
7. Replace the well cap.

Each time a water level measurement is taken, a second confirmation reading is necessary to ensure that the water level is stable. If the second measurement is within ± 0.01 feet of the first, the measurement is good and can be recorded as a stable water level. If the second measurement does not confirm the first, then wait for the well to stabilize and try again.

Indicate in your field notes if the measurements were taken after or during a period of rainfall. Be alert to any irregularities observed which may have an effect on the water levels (such as a nearby pumping well).

Always record the date, time and method of each measurement.

If the measurement references a "holding point" other than the top of the casing, or you are unsure of which point is the top of casing, indicate the reference point used, measure the difference between the top-of-casing and the reference point, and provide a diagram.

Field SOP

Well/Boring Log Guidelines

WELL/BORING LOG GUIDELINES

For every well or soil boring, a separate well/boring log sheet must be completed using standardized well/boring log sheet. On the top half of the sheet are a number of headings with accompanying blanks. It is imperative that all applicable information in this top area be filled out completely for each well or boring.

Well/Boring No.: The numbering sequence is generally provided by the project manager and must be recorded accordingly.

Client: Record the client or project name.

County-Township- This information can be filled out at the office by the project

Fraction-Section: geologist.

Contractor: Give the name of the contractor. Include their complete address. The equipment used should be documented. If a drill rig was used, record the make and the model. The name of the drilling crew chief should also appear here. The supervisor would be the person responsible for overseeing the work in the field.

Drilling Methods: Record the method of drilling that was used. Also, record the diameters of the drill string. Some examples would be:

- 4 1/4" I.D. HSA (inside diameter hollow stem auger)
- 10" O.D. HSA (outside diameter hollow stem auger)
- 3-1/8" mud rotary
- 5-1/2" O.D. x 3-1/4" I.D. dual wall reverse air circulation
- 4" O.D. hand auger

Grouting/Seal: Record the grouting material and the grouting method. If an additive is used, estimate its weight percentage. Also, record the bottom and top depths of the grout.

Development: Include the developing method, rate, pumping time, and total volume evacuated from the well.

Screen: Each item needs to be completed as described on the sheet.

Casing: Record the casing material, diameter, and the bottom and top depths of the casing. Record the top of well thread distance to grade to the nearest 0.1 foot.

Date: Record as indicated on the sheet.

Elevation: Survey elevation data should be recorded here if you have this information. Be sure to include the reference point (whether it is U.S.G.S. datum or a relative elevation). Include the location of your reference point. This information may not always be available to you as the drilling takes place, and it may need to be filled in at a later date by others.

Water Level: In a soil boring, record the first water-saturated level encountered and the elapsed time before measurement. In a well, record the water level using the top of casing as the reference point and note TOC. Also, record the date of the measurement, the time elapsed since development, and the method of measurement.

Location: Reference your sketch and measurements to features evident on the base map which the project manager has supplied. If no base map has been supplied, reference your measurements to permanent site structures.

Well Sketch: Somewhere on the log sheet, a sketch of the well construction should be drawn. On this sketch, show the amount of above-ground stick-up, the depths to joints along the well casing, and the depth of the top and bottom of the well screen.

Remarks: Any added comments that are unique to the boring or well can be recorded here.

On the well/boring log sheet is an area for the lithologic description. The soils or rock that are penetrated during drilling should be recorded as accurately as possible according to the soils classification guidelines. Also on the log sheet, a number should be recorded representing the thickness and depth to base for every lithologic change recorded in the lithologic descriptions.

Another area of the well/boring log sheet offers the opportunity to document soil sample depths, blow counts, and any other readings or measurements taken at individual depth intervals (Hnu, OVA).

Field SOP

Well Casing Volume Calculation

WELL CASING VOLUME CALCULATION

Minimum information and equipment necessary to perform the task:

- well location map
- total depths of the wells
- water level tape
- calculator

Well casing volumes are important to determine the volume of water which must be purged from a well prior to collecting a groundwater sample which is representative of the screened aquifer. Obtaining this value is a two-step calculation:

V = "Pi" r^2H (7.48) is the equation for the volume of a cylinder and is used to make the volume calculation:

ONE:

where:

V =	volume of water in the casing (cubic feet)
"Pi" =	3.14
r =	radius of well ***(feet)***
H =	height of the water column in the well (feet)
7.48 =	converts volume (V) from cubic feet to gallons

It is necessary to evacuate at least three volumes of water before sampling; therefore:

TWO: Vx3 = volume of water to be purged prior to sampling

A simplified form of the equation for the volume of the cylinder is:

$$V = r^2H\ (0.163)$$

where:

$V =$ volume of water in the casing (gallons)

$r =$ the inside radius of the well[1] (*inches*)

$H =$ the height of the water column in the well (feet)

$H = H_0 - H_1$

H_0 = total length of the well measured from TOC

H_1 = the water level measured from TOC

$0.163 =$ a constant

Carefully avoid the possibility of cross-contamination between wells by rinsing water level tape off between wells.

[1] If the field sampling plan requires that the filter pack volume be included, then the well radius used in the calculation should be the borehole radius. For hollow stem augers were used this should be roughly O.D./2.

Field SOP

Field QC Sample Guidelines

FIELD QC SAMPLE GUIDELINES

The following is for guidance to staff who are making decisions in the work plan preparation phase of projects. This guidance applies to projects and clients that may not require field QC samples, but may benefit from the inclusion of them in the sampling plan as circumstances dictate.

With each new project, a conscious decision should be made whether to include QC samples. Agency requirements (e.g., the MDNR Waste Management Division Geotechnical Unit) may be specific for field QC samples. Therefore, be aware of agency requirements when responding to your client's ordered investigation.

TRIP BLANKS

Trip Blanks (organic free water samples in VOC vials placed in lab chest), are renewed each time a chest is packed or repacked with VOC sample containers. These samples remain unopened in the chest. If these "blanks" show "detectable" for one or more compounds, the problem could be cross-contamination between sample and container via air in the chest, or lab contamination.

Be sure these are packed with other volatile organic sample containers when five or more VOC samples will be taken that day, or when two or more sites will be visited on the same sampling trip. If possible, VOC sample containers should be packed and shipped in their own small cooler. VOC sample containers should definitely be separated from other sample containers that are visibly contaminated or "smell".

Analyze the trip blank for phthalates if base neutral compounds are to be run. These are contaminants that can enter samples from "plastic" lab containers and other sources. The laboratory provides trip blanks with every set of semi-volatile bottles.

Trip blank samples need not be analyzed routinely. But if a reported analysis is suspect, the blank can be run. Bear in mind that the value of a blank sample "on hold" decreases with time beyond one or two weeks due to possible communication by other samples via the lab air, and due to holding-time considerations.

FIELD BLANKS

Field Blanks are VOC vials filled in the field sampling area with organic-free water. This is done most often when the work site shows PID readings above the off-site background, or when local background readings can be established as non-zero.

Take one or more of these if the air screening instrument reads 2 ppm or higher above the background in the work area at any time during the day (not including sample-specific readings). This assumes instruments are calibrated in an off-site, clean-air area, where volatile contaminants are non-detect. The high air concentrations can be due to a persistent site condition, or to the presence of volatiles only at times of drilling and surfacing of contaminated subsoils or ground water. Field blanks should also be collected in conjunction with samples where there are vehicles or heavy equipment operating nearby, or when there is noticeable particulate matter.

Pack extra VOC vials, along with organic-free water in a non-reactive container. Obtain one or more blanks during the day by filling and sealing VOC vials with organic-free water while in the work zone. Leave the water container firmly closed otherwise. Analyze the blank taken at the time or closest to the time of the highest work-zone reading made during the day. Additional blanks may be run if conditions warrant.

The field blanks for sampling events involving water VOC samples, and for soil VOC samples prepared by adding organic-free water to a partially soil-filled vial, should be taken if site air readings are 2 ppm or more above ND background. For the usual method of collecting soils by completely filling the vial with soil and without adding water, the threshold may be 5 ppm or more above ND background.

EQUIPMENT RINSE BLANKS

Equipment Rinse Blanks are rinse water samples obtained after the final planned rinsing step for decontamination of bailers, split spoons, lead auger, etc. These blanks demonstrate that the non-dedicated sampling equipment has been thoroughly cleaned and that the sample collection and handling process has not altered the quality of the sample. These blanks typically include containers for all of the pollutant groups being analyzed. This kind of blank is most effective in demonstrating decontamination thoroughness when accompanied by a "before" rinse sample of organic-free water passed through the device immediately after using the equipment.

A field-filtering blank should be collected when samples are filtered in the field.

UTILITY WATER SAMPLES

Utility Water (for drilling fluid make-up, wash/rinse water, etc.) samples should be taken for VOC analysis whenever a new or different source is used. If a source is used for which prior water quality knowledge is unavailable, it is a good idea to run all of the analytical groups being investigated.

Run one sample early in the investigation for all investigative groups unless existing data for the specific source valve indicate there is no need. If any compounds are detectable, rerun a sample of the final tank (drum) for those compounds. Alternatively, find an uncontaminated source of utility water.

DUPLICATE SAMPLES

Under any of the following conditions, obtain duplicate samples:

1. Each day seven or more investigative samples will be taken.

2. One duplicate for each ten samples during the day plus a duplicate sample beyond ten or a multiple.

Example:	0-6 samples during the day	0 duplicates
	7-10 samples during the day	1 duplicate
	11-20 samples during the day	2 duplicates
	21-30 samples during the day	3 duplicates

This means the analytical cost for duplicate samples where seven or more investigative samples are taken will add between 10 and 18 percent to the cost of the investigative samples. Lab discounts for multiple samples will help reduce the cost.

Duplicates may not be needed when a site will be sampled repeatedly, as with a quarterly monitoring sampling schedule.

SPECIAL CONSIDERATIONS FOR DUPLICATE SOIL SAMPLES

Obtain soil (or waste) duplicate samples at the same frequency as water samples. Because of the time required to perform some operations frequently involved with soil sampling--for example, obtaining a partial sample for later head-space screening; splitting the core and discarding "stones"; or describing a particularly detailed core--they can result in differential loss of VOC's from partial samples taken as duplicates. For this reason, volatile organic analyses from duplicate samples can disagree widely. To avoid this, care should be taken to handle duplicate VOC samples in the same manner as the investigative samples, especially the elapsed time between sample collection and sealing of the vials.

Additional problems with soil duplicates include the mass of soil needed for analysis (which sometimes exceeds the volume/mass in the sampler), and the difficulty of obtaining two separate split spoon samples at the same level for use as duplicates. Careful planning needs to be done when volatiles or a critical number of priority pollutant groups are to be analyzed.

The purpose of the duplicate samples should be clear before going to the field. If the purpose is to verify the sample handling and analytical procedures, then a split sample should be collected as a duplicate. If, however, the sampling methodology is to be verified, then a totally separate sample from a closely adjacent or offset location should be collected.

Field SOP

Decontamination, Downhole Sampling Equipment

FIELD DECONTAMINATION, DOWNHOLE SAMPLING EQUIPMENT

This guideline consists of minimum requirements for the decontamination of split-spoon sampling devices, temporary well materials, augers, and water sampling pumps and bailers used at hazardous waste sites for obtaining samples to be analyzed in the laboratory.

The requirements apply foremost to equipment being used to obtain samples for the laboratory and, therefore, are intended to minimize incidents of cross-contamination of samples. The requirements also apply to the auger when contaminated soils are sampled only for on-site identification purposes. This is to avoid cross-contamination of locations particularly when moving from a "dirty" to a "clean" location.

ANALYTE TYPES

Different decontamination steps are recommended for different kinds and physical states of analytes. The analyte types for this purpose are:

- **inorganics**--major dissolved ions, along with heavy metals.
- **dissolved organics**--organics as aqueous species, no "free" organic phase present.
    (1) *soluble organics*--ketones, alcohols, ethers, and others that are fairly to infinitely soluble in water
    (2) *VOC's*--sparingly soluble
    (3) *semi-volatiles*--sparingly soluble
    (4) *PCB's and pesticides*--nearly insoluble in water, but very soluble in oil.
- **free phase organics**--a visible or suspected organic liquid phase, or "oil" from any of various sources. This is usually not an analyte, but when present interferes with analysis of the aqueous phase compounds and presents a strong potential for cross-contamination.
- **combination**

The decontamination procedures apply to equipment in contact with analytes whether present within a soil matrix or as a "free" liquid.

DECONTAMINATION FREQUENCY

With a few exceptions to be mentioned, all named equipment should receive the same kind of decontamination.

UPON ARRIVAL AT SITE

All augers and other equipment provided by the contractor should be decontaminated upon arrival at the site. Equipment provided by Horizon which has not been pre-decontaminated and suitably protected before and during transport to the site should also be decontaminated upon arrival.

DURING SITE ACTIVITIES

All augers should be decontaminated between each location. The split-spoon sampler, temporary well materials, and bailers should be decontaminated between each use. If there is a delay between evacuation and sampling the well, the bailer should be decontaminated before sampling. Pumps and bailers used for well development or redevelopment should be decontaminated before using them for evacuation and sampling.

FIELD DECONTAMINATION PROCEDURES

The approved procedures for decontamination in the field are summarized in the accompanying table.

SOLUBLE ORGANICS, VOC'S AND SEMI-VOLATILES

Tap water is typically used for steam cleaning. Steam cleaning should always be done at "live steam" temperatures, which exceed 212oF. Be sure the steamer water is taken from a public water supply or a source of known and approved quality. If you know or suspect that unvaporized water is carrying over, halt work until the steamer is performing as it should or use an alternative decontamination method. Also, be sure the steam delivery wand is of sufficient length to deliver live steam to any remote points of the equipment.

INORGANICS AND HEAVY METALS

The inorganics and heavy metals call for an initial soapy wash, tap water rinse, and a final DI rinse. Excessive field concentrations of metals may make desirable a dilute nitric acid rinse prior to the DI rinse. The acid rinse need not be done routinely.

OTHER ORGANICS

The oils, PCB's, pesticides, and free organic phases call for a soapy wash and potable water rinse, steam, and a DI water rinse.

SPECIAL SITUATIONS

Certain situations may require a hexane solvent wash and 50% methanol-water solvent rinse in the field, such as PCB oils, coal tars, or motor oils in soils or as a LNAPL. Both solvents have low flashpoints, and normally would be delivered to the site by a DOT-licensed contractor.

The use of hexane should be preceded by a soap and water wash and followed by a 50% methanol-water rinse, steam cleaning and a DI rinse. The "soap" for the soapy wash can be a TSP (trisodium phosphate) product. However, if phosphate or phosphorus is an analyte, a low-phosphate detergent, such as Alconox, should be used.

Pump interior and conductor tubing decontamination, which could be ineffective or result in damage to equipment if steam is used, should follow the table procedure omitting the steam step. A 50% methanol-water solution, if available, may be substituted for the steam cleaning.

DECONTAMINATION UPON RETURN TO HORIZON PREMISES

All downhole equipment which is provided by Horizon that is not decontaminated in the field may be decontaminated in approved locations on Horizon premises upon returning from the field. Procedures are stepwise as follows for routine decontamination:

- Steam cleaning
- Alconox and water wash
- Steam cleaning

- Water wash
- Steam cleaning
- DI water rinse

Decontamination procedures for unusual or special situations should be substituted as described above under the FIELD heading.

Decontaminated bailers will be sealed into clean tubes until they are next used in the field.

ON-SITE STORAGE AND DISPOSAL OF DECONTAMINATION FLUIDS

Before storing fresh or spent methanol-water solutions, fuels, or hexane on site temporarily, assure that the site is secure (enclosed or patrolled) and that bermed containment or a large galvanized tub is provided for secondary containment.

In general, all spent wash and rinse waters including organic rinse liquids should be contained to prevent them from being returned to the ground. All decontamination liquids, along with other incidental waters such as well-development or well evacuation water, should be appropriately disposed. Disposal arrangements or plans should be developed prior to the work, where feasible, and with the client's input and concurrence. Appropriate disposal for liquids may include disposal to an on-site industrial wastewater treatment system.

"Spent" 50% methanol-water solution and spent decontamination water can often be discharged to a POTW via a sanitary sewer by prior arrangement. Because some analytical verification may be required, build some lead time into this request.

RECOMMENDED FREQUENCY OF CHANGING SOAPY WASH WATER AND RINSE WATER

The cleanest way to perform soap and tap water decon is to have a squirt bottle, sprayer or other applicator for the soapy water, and a flowing stream of tap water. In this manner, the soapy water and tap water "reservoirs" are always clean, and equipment comes in contact with clean solutions only.

If you have to use a tub or dip tank for immersion of equipment in soapy water, the following is offered. Related to the frequency of change is the order in which equipment should be decontaminated. Some general guidelines to minimizing the needed changes:

- Wash cleaner (less soiled or "oily") equipment first.

- Have several split-spoon samplers on hand where practical, to save decontamination time and to allow washing these in a batch before the auger needs to be washed.

- Wash bailers in a dedicated soapy solution. This should not often be inconvenient since drilling/soil sampling is usually done separately from well sampling. Having several bailers on hand can allow batch washing of them before a dirtier piece of equipment needs to be washed.

- Wash temporary well casing and screens in a soapy solution dedicated to these materials only.

If a tap water stream is impractical, change the rinse water when it first shows discoloration, floating debris, or foaming tendencies due to soap carryover. Two rinse water baths in series, changing out both when the second bath reaches the above condition, will minimize changes.

Change soapy water when you change the rinse bath, sooner if the soapy water shows a slick that is other than detergent film. Change soapy water when the solution is too "spent" to generate soap/detergent foam with moderate agitation. If, before any of the above indications occurs, the soap solution becomes discolored with suspended clay or silt, it becomes a matter of personal judgment. It is a good idea to have sufficient drum capacity on hand to be able to change the soapy water "more" frequently rather than "less".

Field SOP

Jar Head Space Measurements in Unsaturated Soil Samples

JAR HEADSPACE MEASUREMENTS IN UNSATURATED SOIL SAMPLES (USING FID OR PID)[(1)]

INTRODUCTION:

This procedure is most commonly used at sites where there is a suspected impact from gasoline constituents. The two instruments most commonly used for this field procedure are a flame ionization detector (FID) and a photoionization detector (PID). The FID response is uniform for most volatile gasoline hydrocarbons while the PID response increases for the BTEX compounds. Therefore, the PID may be more effective when concentrating on the aromatic constituents of gasoline.

Most field devices are sensitive to changing weather, and the response of the PID may become significantly affected by an increase in the humidity.

The FID systems, unlike the PID systems, will respond to methane.

GOAL:

To obtain a field estimate of the relative concentrations of total volatile organic compounds (VOC's) contained within a soil sample.

TASK-SPECIFIC EQUIPMENT NEEDED:

1. Flame ionization detector (FID) or a photoionization detector (PID) equipped with a 10.6 eV lamp.

2. Glass sample jars between 9 and 16 ounces in total capacity.

3. Aluminum foil.

(1) John Fitzgerald, Petroleum Contaminants in Soil, Vol. II, pp. 119-135.

PROCEDURE:

1. Calibrate the FID or the PID as indicated in the instrument manual.

2. Record the calibration procedure and the calibration results in the field notes. If a dedicated log book accompanies the instrument, record the calibration details in it.

3. Collect the soil sample.

4. Place the soil sample into the glass sample jar immediately. Fill the sample jar half-full.

5. Seal the sample jar by placing a clean piece of aluminum foil over the mouth and threads of the jar.

6. Allow the sample to reach approximately 70°F.

7. After a 5- to 10-minute headspace development period, vigorously agitate the sample jar for at least 30 seconds.

8. Immediately insert the probe of the FID or PID through the aluminum foil seal and into the sample jar.

9. Record the maximum meter response as the TOTAL ORGANIC VAPOR HEADSPACE concentration on the Well/Boring log form or the field notes as appropriate.

10. Record any significant changes in the weather (and the apparent humidity) that occur throughout the day.

Field SOP

Soil Boring Drilling using Hollow-Stem Augers

SOIL BORING DRILLING USING HOLLOW-STEM AUGERS

INTRODUCTION:

When the primary objective of the drilling is to obtain soil samples from discreet depths, the hollow-stem augering (HSA) technique of drilling is one of the most effective. The soil is penetrated with five-foot-long, continuous helical flight augers which are driven by a rotary drive head mounted on a hydraulic feed system which pushes the drill stem down or pulls it up. Cuttings are mechanically removed from the borehole by the flights on the HSA's.

GOAL:

To drill a soil boring from which the depths and descriptions of the soils encountered can be accurately logged and to obtain samples of the soils from accurate soil depth intervals.

TASK-SPECIFIC EQUIPMENT NEEDED:

All drilling equipment and labor are supplied by the subcontracted drilling company.

PROCEDURE:

1. Access the drill rig and all necessary equipment to the proposed borehole location.
2. Advance the HSA's to the top of the proposed soil sampling depth.
3. With the augers in place and at rest, remove the center plug from the inside of the augers.
4. Attach a decontaminated split-spoon sampling or other device to the drilling rods.
5. Lower the device inside the HSA to the bottom of the borehole.
6. Drive the device into the soil as described, for example, in the standard operating procedure (SOP) for "Split-Spoon Sampling."
7. Recover the device.
8. Replace the plug inside the HSA and continue drilling to the next sampling depth.

9. When the desired completion depth has been attained, properly backfill the borehole from the bottom up as described in the SOP for "Soil Boring Abandonment" and decontaminate the drilling and sampling tools according to the SOP "Field Decontamination, Downhole Sampling Equipment."

Unless there is a specific need for another size auger, standard procedure is to drill soil borings with 4.25-inch inside diameter HSA's. The outside diameter of these augers is 8.25 inches.

Field SOP

Packing and Shipping Samples for Laboratory Analysis

PROCEDURES FOR PACKING AND SHIPPING SAMPLES

FOR LABORATORY ANALYSIS

GENERAL:

Sample packaging and shipping procedures are based on U.S. EPA specifications as well as Department of Transportation (DOT) regulations (49 CFR). The procedures vary according to sample concentration and matrix and are designed to provide optimum protection of samples and the public.

All samples are to be shipped via Federal Express, Purolator, or Emery as specified in the U.S. EPA Region V Sample Handling Protocol for Hazardous Waste. Shipping containers must be insulated, durable and water tight. Bagged samples are to be cushioned within the shipping container with absorbent packing materials to prevent breakage and leakage (vermiculite, zonolite, bubble pack or similar materials).

SAMPLE QUALITATIVE CONCENTRATION DEFINITIONS:

Low concentration organic samples are those containing less than 10 ppm of any of the "priority pollutants" including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, and cyanide. Medium concentration inorganic samples are those containing between 10 ppm and 15 percent of any of the priority pollutants. High concentration inorganic samples are those containing above 15 percent of any of the priority pollutants. Concentrations of the samples can be estimated by using existing data, if available.

Step by step packing instructions are provided below.

LOW CONCENTRATION SAMPLES:

1. Prepare cooler(s) for shipment.

- Tape drain shut.
- Affix "this Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.

- Place mailing label with laboratory address on top of cooler(s).
- Fill bottom of cooler(s) with about three (3) inches of vermiculite.
- Place appropriate chain-of-custody (COC) records on top of each cooler.

2. Arrange decontaminated sample containers in groups by sample number.
3. Mark volume levels on bottles with a grease pencil.
4. Secure appropriate sample tags around caps / lids of containers with string or wire.
5. Arrange containers in front of assigned cooler(s).
6. Arrange containers in coolers so that they do not touch.
7. If ice is required to preserve the sample, cubes should be repackaged in double zip-loc bags and placed on and around the containers (especially on VOC vials).
8. Fill remaining space with absorbent material to prevent breakage.
9. Sign chain-of-custody form and indicate the time and date it was relinquished to Federal Express, Purolator, or Emery.
10. Separate the copies of COC forms. Seal proper copies within a large zip-loc bag and tape to inside lid of cooler. If you are not returning to the office within the week, place remaining copies in a large mailing envelope to be sent to the Horizon project manager.
11. Close lid and latch.
12. Tape cooler shut on both ends, making several complete revolutions with strapping tape (do not cover custody seals).
13. Relinquish to Federal Express. If you are not returning to the office within the week, place airbill receipt inside the mailing envelope and send to the Horizon project manager along with the other documentation (Item 10).

MEDIUM AND HIGH CONCENTRATION SAMPLES

Medium and high hazard samples shipped by Horizon Environmental Corporation personnel are subject to DOT regulations. Therefore, to comply with the prescribed regulations, all Horizon personnel must abide by the following procedures.

1. Collect samples in appropriate containers as required. Assure that the sample container cap is sealed with tape.

2. Attach sample tags to each sample as required.

3. Place each sample in a zip-loc bag in such a way that the sample tag can be read.

4. Place each sealed bag inside a metal can and fill the can with absorbent cushioning material such as vermiculite. The can must be sealed, preferably using clips but tape may also be used.

5. Place the name and address of the laboratory on the can.

6. Place a "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." label on the can.

7. Place a "cargo Aircraft Only" label on the can.

8. Place each can in the shipping container (cooler) which has been lined with two (2) inches of absorbent material.

9. Surround each can with absorbent material to prevent sample breakage and provide stability during transport; fill the shipping container with absorbent material.

10. Place all shipping paperwork to accompany the samples, excluding the airbill and Shipper's Declaration of Dangerous Goods, in a manila envelope. Secure the envelope in a zip-loc bag and place the bag on top of the absorbent material in the cooler.

11. Close and seal the cooler using strapping tape.

12. Mark the shipping container with the following information and labels:

- Shipping address.

- Laboratory address (consignee).

- "This End Up", with arrow, label (for liquids only).
- "Cargo Only Aircraft" label.
- "Inside Containers Comply with Prescribed Regulations" label.
- "Flammable Liquid" or "Flammable Solid" label.
- Additional hand-written label indicating DOT proper shipping name, e.g., "Flammable Liquid, n.o.s. UN1993, or "Flammable Solid, n.o.s. US 1325" (This is required only if the "Flammable Liquid" or "Flammable Solid" labels do not exhibit the applicable DOT proper shipping name). These labels need only be placed on one face of a cooler. Packages having a volume greater than 64 cu. ft. (4'x 4'x 4') require labeling on two (2) sides or ends.

13. To ship packaged samples, the samplers need only to fill out an airbill and for medium and high hazard samples, a Declaration of Dangerous Goods.

14. Same as step #13 for low concentration.

Individual Federal Express offices may have different preferences for completing the Dangerous Goods form. Prior to sampling, it is recommended that you contact the office from which you are shipping and also call the Federal Express 1-800 number (on the airbill) and ask for their "Hazardous Materials shipping section".

Field SOP

Field Determination of pH

FIELD DETERMINATION OF PH

GROUND WATER, SURFACE WATER AND LEACHATE ANALYSIS

Method Summary

The measurement of pH is a determination of the activity of the hydrogen ions by potentiometric measurement.

Interferences

Temperature is an important factor. The temperature compensator attached to the instrument automatically corrects the pH value displayed by the meter.

Instrumentation

Beckman pH meter

pH probe

Automatic Temperature Compensator (ATC)

Materials and Reagents

Sample cups

Prepared pH 4 and 10 standards for calibration

Calibration

During initial setup and calibration, two standards are run.

Standardizing the Instrument

1. Depress the CLEAR key to clear the instrument.
2. Rinse the electrode with distilled water and immerse in pH 4 buffer. Depress the STANDARD key. When the input from the electrode is stable, the instrument will automatically standardize on the pH value of 4.00 pH buffer. The STD1 symbol and the approximate value of the pH 4.00 buffer will appear in the DISPLAY.

3. Rinse the electrode with distilled water and immerse in pH 10 buffer. Depress the STANDARD key again. When the instrument stabilizes, the DISPLAY will include STD1, STD2, temperature and the approximate value of the pH buffer 10.

4. The instrument is now ready to make a pH measurement. Rinse the electrode with distilled water and immerse in the sample.

5. Depress the pH key. Wait until the AUTO symbol flashes and then locks. The DISPLAY will indicate the measured temperature and pH.

6. This sequence can be repeated for additional pH measurements. Depress the pH key, wait for AUTO READ to lock, and note the pH value.

7. A +/- 0.05 pH acceptance limit should be used in determining calibration acceptability. If unacceptable, recalibrate.

Measurement Procedure

1. Prepare and analyze samples without delay.

2. Place about 50 mls of sample into a plastic cup and stir with the pH probe.

3. Allow the pH reading to stabilize. Collect three pH readings from each sample within $\pm$ 0.5 units. Record the pH values on the well or surface water sampling record form. Rinse the probe with distilled water and verify calibration by submersing in a prepared pH standard as described under "Calibration".

4. Proceed to the next sample or location; verify calibration before each measurement.

Quality Control

1. Document all calibrations and verification readings, including time and meter readings.

2. Run duplicate measurements on each batch or every 10th sample.

Maintenance

1. Check battery (if used in field); and replace if discharged.

2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. Immerse the lower third of the electrode in diluted HCL (1:9) solution for 10 minutes to remove any film formed. Rinse thoroughly with water.

3. Keep electrode properly filled with appropriate filling electrolyte solution.

Field SOP

Field Determination of Conductivity, Method 205

FIELD DETERMINATION OF CONDUCTIVITY, METHOD 205

GROUND WATER, SURFACE WATER AND WASTEWATER

Method Summary

Conductivity is a numerical expression of an aqueous solution's ability to carry an electric current. This is dependent on the presence of ions, their concentrations, mobility, valence, and on the temperature of the solution.

The conductivity probe is immersed in a sample and the conductivity is read directly off of the meter scale.

Interferences

Temperature greatly influences the electrolytic conductivity of a sample, therefore, it is extremely important accurate temperature measurements are made.

Instrumentation

Conductance meter YSI Model 32.

Materials and Reagents

Conductivity cell

Thermometer

Specimen containers

Standard

Primary Working Standard:

Potassium chloride standard 0.01N: dissolved 0.7456 g anhydrous KCl in deionized water and dilute to 1 liter at 25°C. Conductivity = 1,413 umhos/cm.

Calibration

Check the conductivity of the standard prior to actual sample evaluation. Record the temperature of each standard.

Calculate the conductivity at 25°C making adjustments for the temperature (see "Calculations", below).

Procedure

1. Measure the conductivity of each sample by swirling the cell in a portion of the sample. Record the conductivity reading and the temperature. Collect three conductivity readings Rinse the cell with deionized water.

2. until the readings are within ±5 umhos/cm.

3. Calculate the conductivity at 25°C as outlined in "Calculations", below.

Calculations

$$\text{Conductivity at } 25^{\circ}\text{C} = \frac{K}{1 + 0.0191(t-25)}$$

K = measured conductivity

t = temperature of sample, °C

Quality Control

- Document all calibrations and verification of readings including time and meter readings.
- A blank of deionized water is run and should have a conductivity of less than 5 umhos/cm.
- The initial standard is checked in between samples.
- Duplicate measurements of conductivity will be taken at least once for every 10 investigative samples.

Field SOP

Soil and Ground Water Sampling Using the Geoprobe

SOIL AND GROUND WATER SAMPLING USING THE GEOPROBE

The geoprobe system of samplers and tools is used for the collection of discreet soil and ground water samples. This system incorporates stainless steel sampling tubes with disposable liners and mechanisms for sample collection at specific depths with the intent to collect soil profile samples with minimal disturbance of the existing conditions and small diameter screens or slotted pipe for the collection of soil vapor or ground water samples.

Several different methods are used to advance the sampling tools to depth. The method used is often dependent on accessibility to the sample location and type of materials being sampled. Sampler advancement can be by impact hammer, hydraulic force or hand driven methods. Sampler extraction most often is by hydraulic force.

LIMITATIONS

Specific site conditions can also limit this method of sampling with the presence of rubble and debris and equipment accessibility problems. Because this method introduces the sampler through the same uncased hole for each sample interval the potential for cross-contamination must be considered.

SOIL SAMPLE COLLECTION AND HANDLING PROCEDURE

All sampling equipment are properly decontaminated before sample collection begins. Samplers incorporate a disposable liner to assist in sample handling and reduce sampler decontamination. Sampler liners are available in several different material composition.

Large Bore Sampler: A 24-inch long x 1-3/8-inch diameter piston-type soil sampler capable of recovering a discrete sample that measures up to 320 ml in volume, in the form of a 22-inch x 1-1/16-inch core contained inside a removable liner.

Liner: A 24-inch long x 1-1/8-inch diameter removable/replaceable, thin-walled inserted inside the Large Bore Sampler body for the purpose of containing and storing soil samples. Liner materials include brass, stainless steel, Teflon, and clear plastic (either PETG or cellulose acetate butyrate).

The assembled Large Bore Sampler is connected to the leading end of a Geoprobe brand probe rod and driven into the subsurface using appropriate methods. Additional probe rods are connected in succession to advance the sampler to depth. The sampler remains sealed (closed) by a piston tip as it is being driven. The piston is held in place by a reverse-threaded stop-pin at the trailing end of the sampler. When the sampler tip has reached the top of the desired sampling interval, a series of extension rods, sufficient to reach depth, are coupled together and lowered down the inside diameter of the probe rods. The extension rods are then rotated clock-wise (using a handle). The male threads on the leading end of the extension rods engage the female threads on the top end of the stop-pin, and the pin is removed. After the extension rods and stop-pin have been removed, the tool string is advanced an additional 24 inches. The piston is displaced inside the sampler body by the soil as the sample is cut. To recover the sample, the sampler is recovered from the hole and the liner containing the soil sample is removed.

Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sands, or rubble. Pre-probing can prevent unnecessary wear on the sampling tools. A Large Bore Pre-Probe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval. Where surface pavement is present, a hole may be drilled with the Geoprobe using a drill steel with a 1.5-inch diameter carbide drill bit prior to probing. For pavements in excess of 6 inches, the use of compressed air to remove cuttings is recommended.

Sample Collection

1. When sampling depth has been reached, position the drive equipment away from the top of the prove rod to allow room to work.

2. Insert an AT-67 Extension Rod down the inside diameter of the probe rods. Hold onto it and place an AT-68 Extension Rod Coupler on the top threads of the extension rod (the down-hole end of the leading extension rod should remain uncovered). Attach another extension rod to the coupler and lower the jointed rods down-hole.

3. Couple additional extension rods together in the same fashion as in Step 2. Use the same number of extension rods as there are probe rods in the ground. The leading extension rod must reach the stop-pin at the top of the sampler assembly. When coupling extension rods together, you may opt to use the GW-469 Extension Rod Jig to hold the down-hole extension rods while adding additional rods.

4. When the leading extension rod has reached the stop-pin down hole, attach the AT-69 Extension Rod Handle to the top extension rod.

5. Turn the handle clockwise (right-handed) until the stop-pin detaches from the threads on the drive head. Pull up lightly on the extension rods during this procedure to check thread engagement.

6. Remove the extension rods and uncouple the sections as each joint is pulled from the hole. The Extension Rod Jig may be used to hold the rod couplers in place as the top extension rods are removed.

7. The stop-pin should be attached to the bottom of the last extension rod upon removal. Inspect it for damage. Once the stop-pin has been removed, the sampler is ready to be re-driven to collect a sample.

8. Reposition the Geoprobe Drawing equipment over the probe rods, adding an additional probe rod to the tool string if necessary. Make a mark on the probe rod 24 inches above ground surface (this is the distance the tool string will be advanced).

9. Attach a drive cap to the prove rod and drive the tool string and sampler another 24 inches. Do not over-drive the sampler.

10. Remove the drive cap on the top prove rod and attach an AT-12B Cap

11. Sampler retrieval can be by hydraulic force incorporating a jacking device or by methods like the Geoprobe vehicle-mounted machine that is designed to both tow and retrieve sampling equipment.

Sample Recovery

1. Detach the 2-foot probe rod it is has not been done previously.

2. Unscrew the cutting shoe using the At-669 LB Cutting Shoe Wrench, if necessary. Pull the cutting shoe out with the liner attached. If the liner doesn't slide out readily with the cutting shoe, take off the drive head and push down on the side wall of the liner. The liner and sample should slide out easily.

3. The ends of the liners can be capped off using the AT-641 Vinyl End Cap for further storage or transportation. A black end cap should be used at the bottom (down end) of the sample core and a red end cap at the top (up end) of the core.

4. On brass, stainless steel, and teflon liners, cover the end of the sample tube with At 640T Teflon Tape before placing the end caps on the liner. The tape should be smoothed out and pressed over the end of the soil core so as to minimize headspace. However, care should be taken not to stretch and, therefore, thin the teflon tape.

5. Large Bore Clear Plastic and Teflon Liners can be slit open easily with a utility knife for the samples to be analyzed or placed in appropriate containers.

6. Large Bore Brass and Stainless steel liners separate into four 6-inch sections. The AT-659K Large Bore Manual Extruder may be used to push the soil cores out of the liner sections for analysis or for transfer to other containers.

Decontamination

Sampling equipment decontamination can be one or a combination of soapy water wash and clean water rinse; steam cleaned, or a solvent wash and clean water rinse, dependent on analytical and cross-contamination concerns.

GROUND WATER SAMPLING PROCEDURE

All sampling equipment will be properly decontaminated before sample collection begins. The objective of this procedure is to drive a sealed stainless steel screen to depth, open the screen, and obtain a water sample via a tubing system to the surface.

Screen Point Ground Water Sampler: The assembled Screen Point Sampler (P/N GW-440K) is 1.0 inch O.D. (outside diameter) x 36-inch overall length. This sampler features a 19-inch screen encased in a perforated stainless steel sleeve. The device is also useful for measurement of piezometric levels.

The assembled Screen Point Sampler threads onto the leading end of a Geoprobe probe rod and is driven into the subsurface using appropriate methods. Additional probe rods are connected in succession to advance the sampler to depth. While the Screen Point Sampler is being driven to the desired sampling depth, it is kept sealed by O-ring connections placed at critical locations on the assembly.

When the desired sampling depth is reached, the sampler is pulled up about 2 feet which disengages the expendable drive point and creates an open borehole from which to sample. The inner core, which consists of a stainless steel sire screen inside of a perforated stainless steel sleeve, is then pushed out into the borehole and water is allowed to enter the sampler and connected probe rods.

In common practice, ground water samples are recovered by pumping or bailing of water collected in the open probe rods. Alternately, tubing from the surface may be connected directly to the sampler screen using a Geoprobe PR (post run) fitting, and samples recovered using a peristaltic pump or vacuum source. The pore size of the screen of this sampler is .0057 inches (0.145 mm). This sampler will allow the user to collect relatively clean water samples in a short time period due to its large surface area.

Sampler Installation

- Drive the water sampler approximately two-foot below the depth level where you want to sample by simply attaching it to Geoprobe rods.

- Never drive the water sampler without the O-ring (P.N GW-445R) attached to the drive point. Failure to use this O-ring may result in flowing soils to clogging the screen during driving.

- Retract the probe rods from the ground a distance of 24 inches (607 mm).

- Insert Geoprobe stainless steel extension rods (P/N AT-67) down the bore of the probe rods. An extension rod coupler (P/N AT-68) must be placed at the bottom end of the lead extension rod in order to protect the threads at the end of this rod. One extension rod will be required for each probe rod in the ground, plus one extension rod for the screen point sampler itself. Place an extension rod handle (P/N AT-69) at the top of the extension rod string.

- When the proper number of extension rods have been coupled together and inserted down the bore of the probe rods, the last extension rod will protrude from the top of the probe rods a distance of approximately 24 inches (607mm).

- Pushing down ton the extension rods should now push the screen out into the formation. When the screen is completely pushed out, the extension rod handle will come to rest at a final position approximately 3 inches (76 mm) above the top of the probe rods.

- In extreme situations, it may be necessary to tap on the top of the extension rod handle with a hammer in order to force the screen out into the formation.

Ground Water Sample Collection

There are two methods for obtaining a sample from the GW-440 series Screen Point Sampler. Ground water samples can be obtained by bailing or pumping directly from the bore of the probe rods above the screen point. Alternately, a tubing system may be attached directly to the top of the deployed screen and samples pumped to the surface using either a peristaltic pump or other means of vacuum lift.

Bottom Check Valve Sampling

The most common methods employed is to pump directly from the bore of the probe rods immediately above the screen point using a tubing bottom check valve. This method is often referred to as sampling from the open rods, and is essentially the same for bottom check valve sampling as it is for bailing. Note that in order for this method to be employed, the piezometric head in the saturated formation must be above the top of the deployed screen point; water from the formation must rise into the probe rods where it can then be pumped to the surface. Sampling is performed as described in the following steps.

- Either 3/8 (9.5 mm) O.D. Teflon (P/N TB-30T) or Polyethylene (P/N TB-25L) tubing may be used for ground water sampling. Selection of tubing material should be based on the analytes of interest and the purpose of the ground water investigation.

- Place a tubing check valve (P.N GW-42) at the bottom end of a roll of tubing (fig. 4.12). This bottom check valve will fit either of the tubing types listed above.

- Push the tubing, check valve end first, down the bore of the probe rods until it strikes the top of the screen point sampler.

- Lift the tubing approximately 4 inches *(102 mm) off the bottom (top of the screen point sampler) and oscillate the tubing up and down in 8 to 12 inch (200 to 300 mm) strokes. In field practice, the tubing is oscillated up and down by hand at a rate of 60 to 100 strokes per minute. This pumping can yield as much as 500 milliliters of sampler per minute.

- Air bubbles appearing in the pumped stream indicate that the pumping action is exceeding recharge from the screen point, allowing air to enter at the check valve end. For most purposes, intermixing of air with the pumped sample is undesirable. The pumping rate should be slowed and balanced with the recharge rate.

- If water cannot be pumped to the surface, sufficient sample may be obtained by using the tubing and check valve as a bailer. Oscillate the tubing to fill it with several feet of sample and then remove the tubing from the rods.

Sampling Through PRT

"PRT" (post run tubing) refers to a Geoprobe proprietary system of tubing and fittings that are used both for vapor and ground water sampling. This tubing is inserted down the rods after the sampler has already been driven to depth and has been deployed for sampling. The top of the screen point sampler screen is equipped with a PRT fitting which serves as a receptacle for a corresponding PRT adapter fitted onto the end of the sample tubing.

In practice, the tubing with PRT adapter at the lower end is inserted down the bore of the probe rods and screwed into the receptacle on the top of the sampler screen. This procedure forms a vacuum tight sample train from the sampler screen to ground surface.. Sample is normally pumped to the surface using a peristaltic pump or other vacuum source.

The advantage of this method is that the sample is only placed in contact with the stainless steel sampler screen and the sample tubing. The sample is never exposed to a free surface. The disadvantage of this method is that it is limited to maximum ground water depths of 20 to 28 feet (6 to 8.5m) below ground surface.

The following procedures are used to obtain ground water samples using PRT fittings and tubing:

- Either 3/8 inch (9.5 mm) O.D. Teflon (P/N TB-30T) or Polyethylene (P/N TB-25L) tubing may be used for ground water sampling. Selection of tubing material should be based on the analytes of interest and the purpose of the ground water investigation. Each of these tubing's has a corresponding PRT adapter that will be required for this sampling. These adapters are shown in the following table.

TUBING AND PRT ADAPTERS

Tubing	Description	PRT Adapter Part Number
TB-30T	3/8 inch (9/5 mm) TFE	PR-30S
TB-25L	3/8 inch (9.5 mm) LDPE	PR-25S

- Place the barbed end of the appropriate adapter into the selected tubing.
- Push the adapter end of the tubing down the bore of the probe rods until it comes into contact with the PRT threads at the top of the screen point sampler.
- Rotate the tubing counter-clockwise at the surface to screw the adapter in to the screen point threads. Rotate the tubing several revolutions until the down hold adapter is completely seated and the tubing starts twisting. In this condition, the tubing will rotate backwards (clockwise) when released.
- The tubing can now be attached to a peristaltic pump or vacuum source at the surface.
- After sampling is complete, tubing should be removed by pulling it up at the surface. This will pull the tubing off the barbed end of the tubing adapter and will allow the operator to examine the connection at the top end of the screen point when it is pulled from the ground.

Sampler Removal

- Remove all sampling tubing from the bore of the probe rods.
- Pull all probe rods from the ground using the extraction equipment. Care should be taken not to push down on the probe rods during removal.

- Care should be taken to lift the screen point sampler vertically upward at the surface. Pulling the probe rods or sampler from the ground at any direction other than vertical may result in bending of the screen point sampler.

- Dismantle the sampler at the surface and examine if for damage. Decontaminate all parts, replace all O-rings, and reassemble the sampler for the next sample.

Decontamination

In order to assemble the water sampler properly and to take accurate and precise water samples, all parts need to be cleaned thoroughly and, if necessary, individually decontaminated prior to their use. For each test run, fresh, decontaminated sampler parts and O-rings should be used.

All parts should be washed with soapy water. All soil adhering to the parts should be removed by brushing or pressure washing. Finally, all parts should be rinsed with clean, contaminant-free water and allowed to dry before they are assembled.

Check all five O-rings in the sampler assembly for damage and/or wear. For reliable tests, we recommend the use of new O-rings on this tool at each sampling. It is more efficient and cost effective to change O-rings rather than collecting a non-representative sample or invalid data.

Field Sampling SOPs

Permanent Wells Installed Through Hollow Stem Augers

INSTALLATION OF PERMANENT MONITOR WELLS

WITH HOLLOW-STEM AUGERS

The objective of any monitor well installation is to obtain a representative ground water sample from a desired depth interval. That sample should be obtained with a minimum of disturbance to the soil, ground water flow, and ground water chemistry in the aquifer.

PROCEDURE:

Under ideal conditions, the construction of a monitor well inside the augers is straight-forward:

1. Advance the HSA to the desired depth.
2. Remove the center plug.
3. Seal all the well joints with Teflon tape.
4. Install the decontaminated well components.
5. Set the well screen on the bottom of the hole. Pour the coarse grade sand inside the HSA to fill the annulus between the well screen and the borehole as the augers are pulled back. The sand pack should extend at least 1 to 2 feet above the top of the screen.
6. Install a graded pack around the well screen.
7. Pull the bottom of the auger string back to a depth just above the sand pack.
8. Seal the sand pack from the upper portion of the remaining borehole annulus with 1 foot (minimum) of pelletized or coarse grade bentonite placed above the sand pack.
9. Pull the bottom of the auger string back to a depth just above the bentonite seal.
10. Tremie grout the remaining annular space. (The inside diameter of the augers has been carefully selected to allow enough room for a tremie rod to be lowered along the well casing inside the augers.) A cement/bentonite grout is mixed at the surface and

pressure pumped down through the tremie rod to fill the annular space from the bentonite seal up to a depth of 2 feet below the land surface.

11. Finish the well construction at the ground surface with either a locking flush-mount cap or a locking protective casing set in concrete which slopes away from the well so that surface water is diverted away from the well casing.

12. Develop the well until sediment-free water is produced. The well should be developed by a method which surges water into and out of the screen until relatively particle-free water is produced. It is best to perform the development after the grout has set.

If the hollow stem I.D. will not allow a tremie rod, a clean flexible hose may be lightly taped to the length of the well casing prior to insertion to provide a conduit for delivering grout at depth.

All well construction data will be recorded on the standard well/boring log forms.

Field Sampling SOPs

Standard Photoionization Detector (PID) Operations and Procedures

STANDARD PHOTOIONIZATION DETECTOR (PID) OPERATIONS AND PROCEDURES

Introduction

The HNU Model PI 101 is designed to measure the concentration of trace gases in the atmosphere. The principle of photoionization detection (PID) is employed. A sensor, consisting of a sealed ultra-violet light source (either 9.5 eV, 10.2eV, or 11.7 eV) emits photons energetic enough to ionize many trace species of organic hydrocarbons. The ionized gases are in turn detected by a collector electrode where the current is measured and converted to a ppm value. The useful range of the instrument is from a 1 ppm to 2,000 ppm. This instrument is used frequently by WW Engineering & Science to evaluate ambient air quality for health and safety purposes and to detect the presence of volatile organic hydrocarbons in soil and sediment samples.

Operation

1. Turn the function switch to the "battery check" position. The needle on the meter should read within the green area (battery area) of the scale; if not, the battery should be recharged.

2. Turn the function switch to the "on" position. Look into the end of the probe and confirm the purple glow of the UV lamp.

3. Zero the instrument; turn the function switch to the "standby" position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation = upscale deflection; no calibration gas is necessary for this adjustment. Confirm zero rating is stable; if not, readjust.

4. Calibrate the instrument; turn the function switch to the proper measurement range (specific to the calibration gas). Connect the sensor to the provided cylinder of calibration gas, open the valve on the cylinder. Use the span control to adjust the instrument scale reading to the ppm value specified on the cylinder of calibration gas. The instrument is now ready for use. Be sure to position the function switch to "stand-by" between observations to prevent unnecessary drain on the battery.

5. To prevent the undetected escape of volatile vapors when scanning split-spoon soil or sediment cores, have the instrument at the ready when the split-spoon is opened. Immediately upon opening the corer or split-spoon, disturb the sample and scan representative areas of the sample.

6. The battery should be recharged each night. To charge the battery, place the mini-phone plug into the jack prior to plugging in the 120 VAC. When disconnecting the charge, remove from the 120 VAC before removing the mini-phone plug. Check the battery to confirm its charge.

7. If the probe is held near AC power lines or transformers, an error may be observed. If AC "pick-up" is going to be a problem, the meter, in "stand-by" position, will indicate the magnitude of the error rather than reading zero. This may be taken into consideration and the error compensated for by simply subtracting the value observed when the instrument was on stand-by from the observed detected value when making a positive reading.

8. The HNU PID is affected by humidity. It will not function properly in rainy weather, and "negative" deflection and difficulty with zeroing the instrument can occur under otherwise humid conditions.

Appendix C

Field Forms

Field Forms

Well/Boring Log Sheet
Water Level and Field Record Form
Ground Water Sampling Field Record Form
Sample Tag
Internal Field Audit Checklist
Survey
Pump Test Data

HORIZON ENVIRONMENTAL

Page: ______ of ______
Boring No. ______
Completed Well No. ______
Client: ______
Project No.: ______
Date: Started: ______ Finished: ______
Time: Started: ______ Finished: ______

Well/Boring Log Sheet

State	County	Township	Fraction	Section	T	R

Contractor: ______
Address: ______
Equipment: ______
Crew Chief: ______
Horizon Supervisor: ______

Drilling Method(s)	Depth

Ground Surface Elevation (feet):	
TOC Elevation (feet)	
Datum (feet)	
Static Water Level:	
Reference	

Grouting/Seal

Depth/To	Material/Method

Location:
Description: ______
Sketch:

Construction: ___ Abandonment: ___ Aditional Field Notes: Log Book Computer File

Thick-ness (feet)	Depth to base (feet)	USCS *	Lithologic Description

Sample Depth	Blow Counts 6"	12"	18"	24"	Headspace	Background

* = The USCS symbol assigned is based on visual and manual observations and not on tests performed in the laboratory.

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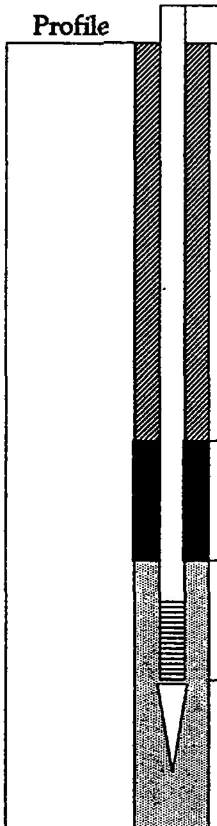
Project Name: ____________________

Project No: ____________________

Log of Well Installation

Well Number: ____________________

Generalized Subsurface Profile



Length of Casing Above Ground Surface

Concrete Cap

Depth to Top of Grout or Backfill

Material (Grout or Backfill)

____

____

Depth to Top of Bentonite Pellets/Slurry

Circle one

Depth to Top of Filter Pack

Type ____________

Depth to Bottom of Well Screen

Borehole Backfill Material

Total Depth of Borehole

Top of Casing Elevation (feet):

Water Level Data

Date	Time	Water Level	Elevation

Development: ____________________

____

Survey Reference: ____________________

____

Well Casing
- Diameter: ____________
- Total Length: ____________
- Material: ____________
- Cap Type: ____________

Well Screen
- Diameter: ____________
- Length: ____________
- Slot/Type: ____________
- Material: ____________

Protective well casing
- Material: ____________ Dia. ________
- Height Above Ground: ____________
- Lock Type: ____________

General Notes: ____________________

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Water Level and Field Record Form

Client: ______________________ Job Description: ______________________

Project No.: ______________________ ______________________

Date: ______________________ ______________________

	(a)	(b)	(c)	(d)	(e)		
Well No.	Elevation Top of Casing (T.O.C.)	Point Held On Tape (ft.)	Distance Wet On Tape	Depth To Water Below T.O.C. (b-c)	Elevation Of Water (a-d)	Time of Meas.	Remarks (weather, etc.)

HORIZON ENVIRONMENTAL

Groundwater Sampling Field Record Form

033

Client: ______________________________ Job Description: ______________________

Project No: ____________________________ ______________________

Date: ________________________________ ______________________

Well No.	Date Sampled	Priming Water Used (gal.)	Pumping Rate (gpm.)	Time Pumped (min.)	Volume Discharged (gal.)	Sampling Method	Remarks

Analytical Services

EARTH TECH

5555 Glenwood Hills Parkway SE
PO Box 874
Grand Rapids MI 49588-0874

Client: ____________

Project Number: ____________

Date: ____________ Time: ____________

Preservative: 1+1 HCl

Sampled By: ____________

Sample Location: ____________

YELLOW

APPENDIX C

INTERNAL FIELD AUDIT CHECKLIST

Name of Inspectors: ______________________________
Date of Inspection: ______________________________

1. **Review The Field Logbook Records.**

Is each field logbook a bound field survey book or notebook?

Is each logbook stored in the document control center when not in use?

Is each logbook identified by the project-specific document number?

Does each logbook contain a title page with the following information:
- Person to whom the logbook is assigned?
- Logbook number?
- Project name?
- Project start date?
- Project end date?

Does each daily entry in the logbook begin with the following information:
- Date?
- Start time?
- Weather?
- Names of all sampling team members present?
- Level of personal protection used?
- Signature of person making the entry?

Are the names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit entered into the logbook?

Are all measurements entered into the logbook?

Are all collected samples entered into the logbook?

Are all entries made in ink?

Are any erasures present?

Are incorrect entries crossed out with a single strike mark?

Is a detailed description of the location of the station which was sampled or measured including compass and distance measurements noted in the logbook?

Are the number of photographs taken, if any, recorded?

Is all equipment used to make measurements, along with the date of calibration, recorded?

Is all equipment used to collect samples recorded?

Is the time of sampling recorded?

Is the sample description recorded?

Is the depth at which the sample was collected recorded?

Is the volume and number of containers recorded?

2. **Review the Chain-of-Custodys**

Are all samples accompanied by a properly completed Chain-of-Custody form, including sample numbers and locations, signatures, date and time of transfer?

Were the pink and yellow copies of the Chain-of-Custody form retained by the sampler and returned to the sampling office?

3. **Observe the Sample Shipment**

Are samples packaged in baggies and surrounded by vermiculite or bubble pack?

Are they dispatched to the appropriate laboratory?

Are they being sent by overnight carrier?

Is an original, signed Chain-of-Custody form enclosed with each shipment?

Is each shipping container locked and secured with strapping tape and custody seals in at least two locations?

Are the custody seals covered with clear plastic tape?

Were receipts of the bills of lading retained as part of the permanent documentation?

4. **Sample Container Preparation and Preservation** (see Table 4.1 of the FSP)

Were the samples placed into the proper container?

Were they properly preserved?

5. **Decontamination Procedures**

Were all tools which came into contact with potentially contaminated water, soil, or sediment decontaminated after each use?

Were the tools washed in an alconox solution?

Were the tools steam-cleaned?

Were the tools rinsed with distilled water?

If the tools have visible oil or dirt that cannot be removed with conventional decontamination techniques were they sprayed with hexane?

Were the tools wrapped in foil for storage or transportation to prevent contamination?

6. SAMPLE COLLECTION PROCEDURES

Was the static water level measured to within 0.01-foot with an electronic water level probe prior to purging?

Were the static water levels measured in upgradient wells first?

Was a second confirmation reading taken?

Were all observations and data recorded on field sampling forms?

Was the electronic water level indicator rinsed with deionized water prior to and after each use?

Was all purge and sampling equipment decontaminated prior to use?

Were the monitoring wells purged with a stainless steel bailer, Teflon bailer, 1/2 hp submersible pump, 2-inch submersible pump or Well Wizard?

If a pump was used to purge and/or collect the sample, was the gas-powered generator at least 10 feet downwind during sampling?

Was a minimum of three casing volumes purged from the wells?

Were conductivity, temperature and pH monitored periodically during purging?

Were the well sampled after the conductivity, temperature and pH stabilized (within 10% variability between consecutive well casing volumes), and at least three well casing volumes were removed?

Was sampling equipment protected from ground contact by a plastic drop cloth and a decontaminated container?

Were the samples collected with either a stainless steel, Teflon bailer, 1/2 hp submersible pump or Well Wizard?

Was a new length of polypropylene rope used?

Were new latex gloves worn by field personnel during sampling of each well?

Were the monitoring wells sampled at a sufficiently slow rate to prevent agitation inside the well?

Were the contents of the sampling devices transferred to sample containers in a way that minimized agitation and aeration?

Was the ground water at the purge wells sampled via a ball-valve tap at a low flow rate?

At the purge wells, was the sample port opened and ground water allowed to flow for three to five minutes prior to sample collection?

Were the samples for VOC analysis collected first?

Was the volume of sample collected for VOC analysis of sufficient volume to eliminate headspace in the sample container?

Was the rate of flow of water from the bailer into the sample container less than 100ml/minute?

Were ground water samples to be analyzed for dissolved metals filtered at the time of sampling, using a peristaltic pump with an in-line filter?

Were the metals samples preserved with dilute nitric acid?

Were additional ground water samples collected for field analysis of pH, conductivity, and temperature?

Were the probes for field analyses kept from contacting ground water samples for laboratory analyses?

Were the pH and conductivity equipment properly calibrated to the manufacturer's specifications?

Were the meters calibrated daily before use?

Were calibration checks performed after every 10 samples or less?

Were the calibration checks documented on the field forms and in the field log books?

Were all field measurements documented?

Was all purge water treated on-site using the existing ground water remediation system?

Were critical spare parts such as tape, pH probes and batteries kept on-site to reduce down time?

Were backup instruments and equipment available on-site or within a one-day shipment to avoid delays in the field schedule?

7. Soil Borings

Were the soil borings drilled using a 4.25-inch inner diameter hollow-stem auger?

Was a 140-pound hammer free-falling 30 inches used to drive the 3-inch outside diameter, split spoon sampler 24-inches into the undisturbed soil ahead of the lead auger or open borehole?

Were the soil samples collected with a 2-foot long split-spoon sampler in accordance with ASTM Method D1586?

Was the split spoon sampler decontaminated after each sample interval?

Did the field technician log the following information for each sampling interval:

Soil type?
Soil depth?
Soil consistency?
Blow counts?

Was a portion of the sample placed into the inner of two zip-lock storage bags or into an air tight glass jar as soon as the split-spoon sampler was opened?

Was the sample allowed to sit for at least two minutes and allowed to reach room temperature in the sealed container?

Was the head space in the bags then analyzed with a FID/PID?

Was the FID/PID reading recorded on the boring logs?

Was the sample with the highest FID/PID reading and/or greatest visual evidence of impact submitted for laboratory analysis?

Was one sample from each shallow soil boring submitted for laboratory analysis?

Were two samples from each deep soil boring submitted for laboratory analysis?

For the deep borings, was one of the samples collected from the first interval with no indication of impact?

Were the soil samples from the deep borings visually inspected for DNAPLs?

Were the deep soil borings grouted using a cement bentonite grout (95% cement and 5% bentonite) tremied in place?

HORIZON ENVIRONMENTAL

Survey

Horizon Environmental Corporation 4595 Broadmoor SE, Suite 200, Grand Rapids, MI 49512 616 554.3210 Fax 554.3211

Page ______ of ______
Client: ____________________
Project No.: ____________________
Date: ____________________
Survey Team: ____________________

+S	HI	-S	BM. or STA.	ELEVATION POINT DESCRIPTION